# The Dock and Harbour Authority

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## *Editorial Comments*

**The Albert Canal.**

Previous reference has been made in this Journal to the new great Belgian waterway, known as the Albert Canal. In the February issue this year, we were able to announce the completion of the undertaking and its opening to traffic last Christmas, after more than a decade spent in engineering operations to overcome the constructional difficulties of the route, some of them really redoubtable.

Now we are able to present our readers with a comprehensive and connected account of the inception and development of the project, based on the detailed monograph on the subject prepared by Monsieur A. Delmer, Secretary-General of the Belgian Ministry of Public Works under the former national régime.

The book is a highly interesting description of a monumental enterprise, redounding to the credit of the Belgian people and adding greatly to the facilities for inland water-borne traffic in North Western Europe, especially in the great industrial region round Liège and in the immediate hinterland of the Port of Antwerp.

The union of Antwerp and Liège by this connecting link is a happy commercial achievement. The former is the chief port of Belgium and the latter, its leading manufacturing centre. From Antwerp, in normal times, sail some of world's largest liners and a great fleet of merchant shipping. Liège, with its coal mines and metallurgical industries, its steel and iron manufactures, its lead and zinc foundries, besides its great volume of miscellaneous trade, is a great and prolific feeder of the port, in addition to which, in conjunction with the surrounding industrial towns, it gives employment to a great army of workers.

It is unfortunate that, for the present, the utility and advantages of the canal are being diverted to the furtherance of Nazi interests; but, alike in this country and in Belgium, fervent hopes are entertained that the canal will soon be wrested from the hands of its ravishers and restored to its rightful owners.

**The " Port of Birmingham."**

As will be seen from the brief report in this issue of his address to the Grand Union Canal Company, Mr. John Miller, the chairman of the Company, made a strong appeal for full recognition by the Government of national responsibility in regard to the inland waterways of Great Britain. Admitting their present unsatisfactory and neglected condition, he took no pessimistic view of the possibility of their effective rehabilitation, provided that they were released from the " stranglehold " of the railways—a reversal, by the way, of the attitude of canal proprietors in the early days of railway promotion when railway companies were sometimes compelled to acquire the canal undertakings in the districts they proposed to serve. Mr. Miller contended that the very heart of the canal industry from a traffic standpoint was in the Midlands, where railway control was firmly entrenched. He added that Birmingham as a Port was " no dream " and hoped that at the conclusion of the war the Government would realise how far this country is behind Continental countries in the development of inland water transport.

The recent appointment of Mr. Frank Pick to investigate the present positions of British canals shows, at any rate, that the Government are alive to the necessity of dealing with the problem, but, however sincere their intention of remedying the present unfortunate condition into which (with a few exceptions) canals have been allowed to fall, the fact remains that rehabilitation and modernisation will be a lengthy process, and that a number of years must elapse before the leeway caused by obsolescence and decay can be made up.

Meanwhile, as regards making the best use of their existing capabilities, there are several awkward problems to be dealt with, one of the most urgent being the supply of trained bargees. There are boats available for traffic, but a shortage of men to man them. The men must be found, even if they have to be withdrawn from national service in other directions. It is a pity that a training scheme for canal boatmen promulgated by the Ministry of Labour a short time back, was allowed to fall through. The Ministry of Transport, however, has since made an offer of grants towards the cost of employment of inexpert labour while men are being trained.

**The Joint Ministry of Shipping and Transport.**

The step taken by the British Government in amalgamating the Ministries of Shipping and Transport under a single head is fraught with consequences of no little significance to port administration and operation. In another column is published a statement on the matter by Mr. F. J. (now Lord) Leathers, the new Minister of the Joint Departments, in future to be known as the Ministry of War Transport. In the statement explaining the reasons for the change, Lord Leathers rightly emphasises the difficulties which have arisen out of the imposition of an arbitrary line of demarcation at British ports between the functions of the Minister of Shipping and those of the Minister of Transport, regardless of the fundamental fact that the transportation of commercial commodities is, or should be, a continuous and uninterrupted process from place of origin to place of consumption. Lord Leathers points out the advantages to be gained by the concentration, under a single roof, of full information respecting both shipping movements and internal transport arrangements. This will be readily admitted, provided, of course, the right man is at the head of the combined organisation.

Lord Leathers comes to his post with a high reputation for business ability. He is, we understand, a recognised authority on bunkering and has held directorships in a large number of undertakings connected with bunkering, shipping lighterage and the handling of coal and oil. This is all to the good, and it is to be hoped that such valuable experience will enable him to grapple successfully with transport to and from overseas at its crucial stage, viz., the passage through port, hitherto the weak link in the chain.

One important consideration should not be overlooked. The management of port labour is an essential factor in the handling of cargoes, and it would certainly seem desirable that questions relating thereto should not be reserved for the independent, if not exclusive, consideration of the Ministry of Labour. Shippers and others have expressed considerable dissatisfaction with what they describe as a " policy of appeasement " adopted towards a class of port labour—a minority it is true—which apparently has no scruple about availing itself of emergency conditions as a bargaining factor. For the purpose of complete co-ordination of effort and to secure smooth working of the transport system, labour in port work should be placed under the same system of control as shipping and transport movements.

**The Durability of Concrete in Sea Water.**

Some considerable time ago—now getting on for half-a-century—a scare of some magnitude was caused in maritime engineering circles by the circulation of an assertion stated to be substantially verified, that Portland Cement concrete in a marine environment had proved unreliable and subject to disintegration and decay. Support for the allegation was mainly forthcoming from experiences on the other side of the Atlantic, and at a later date, the

## *Editorial Comments—continued*

available evidence was set out in a Paper by Messrs. W. G. Attwood and A. A. Johnson, published in the Transactions of the American Society of Civil Engineers, wherein the authors to account for the phenomenon, put forward a theory which had been propounded in the first instance by the French chemist, L. J. Vicat. This attributed the disintegration to the action of certain salts, especially the sulphate and chlorate of magnesia, contained in sea water. On coming in contact with lime, the magnesia was stated to be precipated as a hydrate, with the simultaneous formation of chloride of calcium and sulphate of lime. Both these products are soluble, especially the former, and are easily removed by the washing action of the sea.

Although a number of eminent authorities in this country and elsewhere adopted the explanation and lent their testimony in support, yet from a long experience of the behaviour of concrete work in dock and harbour waters, we were unconvinced, and set out some countervailing arguments.* We felt, and still feel, that there is little or no ground for mistrust in the durable qualities of sound Portland cement concrete in maritime situations, if properly made and mixed. As however, there still appears to be doubt entertained in some quarters, we are glad to have the opportunity of reproducing in this issue the recent paper on the subject by Mr. Homer M. Hadley read before the American Society of Civil Engineers and published in the Society's Journal.

To this we would add that, if any further assurance is required, it is to be found in the report of a Committee of the Institution of Civil Engineers, appointed in 1916 to investigate the matter in consequence of the agitation raised at that time. As a matter of interest we quote the following extract from the Committee's report.

" Breakwaters, docks and other works of considerable magnitude, mostly of concrete, either in mass or in the form of blocks, have been constructed in different parts of the world during the last forty years or more, without showing the slightest tendency to deterioration or failure, so that . . . it is taken by most engineers as definitely determined that properly constituted Portland cement concrete, employed as it should be, may be relied upon to produce sound and permanent work."

The foregoing remarks apply, of course, to plain concrete work. In reinforced concrete the conditions are different, and an inadequate protective covering over to the steel bar reinforcement may lead to the formation of rust, with consequent expansion and disruption, in no way attributable to the concrete itself. The susceptability of steel to corrosion and its bearing on the design of reinforced concrete piles have been the subject of investigation by a Committee of the Institution of Civil Engineers, working under the auspices of the Department of Scientific and Industrial Research, from which have emanated a series of reports, recording the progress made from time to time in the experimental tests.

### Littoral Drift and Coast Erosion.

On several occasions in the past, there have appeared in this Journal, articles dealing with the subject of coast erosion and its corollary, shore protection. A superficial reader may pehaps have thought that coastal changes had no very close connection with dock and harbour affairs, but a little reflection will show that there is a very marked and intimate connection indeed. In our last issue was published a communication from the Madras Port Engineer, explaining the circumstances under which the Port Trust had embarked on a course of action to counteract the effect of sand travel along the Coromandel Coast, which, latterly, has become so acute as to threaten the accessibility of the harbour within a relatively short period. As an appropriate sequel to this, we now direct our readers' attention to the address publshed in this issue, which was given by Mr. J. Spencer Smith at the last Annual Convention of the American Association of Port Authorities. It will be seen that he enumerates the numerous ways in which port and harbour interests are affected by beach travel, and after due consideration of his exposition, there will be very little doubt that the matter is of very considerable importance.

Indeed, having regard to the interests at stake, it is somewhat surprising to find that so little attention is paid in this country to the ravages of the sea along the coastline, whether abruptly by storm and tempest, or slowly and insidiously by the action of tides and currents. It is now more than 30 years since the matter excited public attention to the extent of securing the appointment of a Royal Commission to investigate the position, and notwithstanding their recommendations (which, as often happens in such cases, were duly pigeon-holed and ignored) and the warning conveyed, it has since been allowed to lapse into oblivion, interrupted only by an occasional paper contributed to a learned society or technical institution.

It may be interesting, as well as serviceable, to recall the terms of reference given to the Royal Commission on Coast Erosion in July, 1906. They were instructed to enquire and report:

(a) As to the encroachments of the sea in various parts of the coast of the United Kingdom and the damage which has been, or is likely to be caused thereby; and what measures are desirable for the prevention of such damage;

(b) Whether any further powers should be conferred upon local authorities and owners of property with a view to the adoption of effective and systematic schemes for the protection of the coast and the banks of tidal rivers;

(c) Whether an alteration in the law is desirable as regards the management and control of the foreshore; and

(d) Whether further facilities should be given for the reclamation of tidal lands.

A considerable volume of evidence was taken on these points, which were sifted and analysed in a final report issued in May, 1911. The following are the findings which emerged. The Committee recommended:—

(1) The establishment of a Central Sea-Defence Authority, the Board of Trade being indicated as a suitable body for the purpose;

(2) The enlistment of the assistance of scientific experts to collate information and to secure systematic observations; and

(3) The preparation of a schedule of tidal lands in the United Kingdom capable of profitable reclamation.

Unfortunately, the Commissioners also came to the conclusion that they could not see any grounds for the contention that sea-defence is a national service. It is true, they added, that there was serious erosion in places, but this did not affect the nation at large. For this reason the making of grants from public funds in aid of sea-defence, they said, was not to be encouraged.

Whatever sound advice was included in the body of the report was entirely nullified by this blank refusal to consider the possibility of affording financial assistance to local authorities and land owners who had been, and were, feeling heavily burdened by their coastal maintenance responsibilities. And so, in spite of the example set by France, Italy and Belgium, where shore protection is regarded as a national duty, Great Britain decided to let matters take their course, with the inevitable result that nothing has been done to check the appreciable annual toll taken by the sea of friable cliff and erodible foreshore, as evidenced by press announcements from time to time of " serious falls " of cliff frontage. A half-hearted attempt was made to pass a Coast Protection Bill in 1929, but it was dropped after the second reading.

It is true that, on balance, there is probably as much accretion in certain places as there is erosion in others, but the result of the two processes is very different. Accretion usually takes the form of sand and shingle, of little or no cultivable value, whereas the land which is lost is mainly fertile and of agricultural utility.

From the point of view of readers of this Journal, the major interest will centre in the effect of beach drift on harbour entrances and river mouths, often resulting in shoaling and the formation of bars, with consequent inconvenience to navigation. The subject, however, is too complex and involved for examination in this editorial note, which is already sufficiently lengthy, and will have served its immediate purpose if, by its means, attention is directed to a general consideration of the whole subject. Readers who wish to pursue the subject of the effect of coastal drift on the origin of river bars are referred to the Vernon Harcourt Lecture on Estuary Channels and Embankments which was reported at length in the issues of May, June and July, 1938.

### Effect of European War on American Port Business.

The difficulties experienced by certain United States ports at the present time in consequence of the British blockade and German submarine activities were the subject of comment by Mr. E. A. Stephens, newly-elected President of the Board of Commissioners of the Port of New Orleans, when in an inaugural address he outlined a comprehensive plan for the development of the port, which is to be undertaken forthwith.

Owing to the loss of world trade, the public cotton warehouse at New Orleans is practically idle and the Board is endeavouring to let the available accommodation on lease, while alternatively attempting to induce the United States Government to store its surplus cotton at the port. " The public grain elevator," continued Mr. Stephens, " is faced with the same problem, namely, the loss of world trade in grain. The solution is also practically the same: leasing the elevator to the federal authorities for storage purposes. One of these days we can probably use both these facilities again to develop business for the port, but when, no man knows. Certainly, at the end of the war, people of this world will want grain and cotton."

The effects of the present war are widespread and far-reaching, and American ports, scarcely less than those in European countries, are feeling the stringency of the times. The timidity of isolationists and pacifists in the United States will have to be over-ruled in the interests of American commerce. The sooner the war is brought to a satisfactory conclusion, indeed, the better for the welfare of the whole world.

The development programme of the Commissioners includes improvements in the Inner Harbour Navigation Canal, the expansion of Latin-American trading facilities, and the dredging of a 40-ft. channel through the passes at the mouth of the Mississippi River.

*Vide " Harbour Engineering," p. 161 in the third edition.

# The Albert Canal

## Description of a Notable Belgian Achievement

AFTER the lapse of a dozen years from its inception and at a cost of some fifteen million pounds, the Great Belgian Waterway, dedicated to the late King of the Belgians and officially named the Albert Canal, has been completed and brought into use.

The concept of linking up the Meuse and the Scheldt by means of a canal entirely within Belgian territory had been entertained by the Belgian people for some considerable time. To provide an outlet to the sea for the industrial region of Liège and bring the traffic through the Port of Antwerp was a project of national commercial value and industrial utility which had naturally commended itself at an early date, and, in fact, had been partially though inadequately effected by means of a series of canal

The Cutting at Caster in progress.

connections, comprising mainly the Zuid Willemsvaart and the Junction Canal between the Meuse and the Scheldt. The route of these waterways was well adapted to the conformation of the country and they formed an excellent navigable channel between Liège and Antwerp, with a one-way slope and long level reaches. But navigation between Liège and Antwerp was hampered by difficulties arising in part out of the passage through Dutch territory at Maastricht. Accordingly, the Belgian authorities sought a solution of the problem by means of a waterway entirely within the national boundary.

### Defects of the Former Canal Route

Moreover, there were other objections to the old route. The canals, constructed a hundred years or so ago, were out of date. They were too narrow and the depth too shallow—The " kastes " of the Campine, with a draught limited to 6-ft. 3-in., could not navigate them when fully laden. The locks were too numerous; there were 24 in a stretch of scarcely 100 miles. There was, certainly, a long unimpeded reach of over 40 miles between Maastricht and Bluestone, but in the remaining length, progress was slow and there were many delays. Certain sections were particularly difficult. The exit from Antwerp was incommoded by swing bridges; at Herentals, the railroad cut the waterway near the station; at Mol, three double locks closely adjacent had to be negotiated, finally, there was the crossing of frontiers at Maastricht. All these constituted a serious impediment to rapid transport. It required on an average 16 days to make the trip from Liège to Antwerp and of this period, 3 days were absorbed in the vicinity of Maastricht.

Obviously, these navigational difficulties increased the cost of transport. A thorough modernisation of the route was essential to achieve the cheapening of the conveyance of goods. The waterway was, in a traffic sense, " saturated "; traffic could not be increased, all increments in the number of craft produced congestion, which paralysed movement. A radical expansion in the capacity of the waterway was called for, in order to meet growing requirements. It was a question of the prosperity of the Belgian ports, of the development of the coaling industry of the Campine and of the existence, itself, of heavy industry in the Liège region.

### Belgian Port Development

The ports of Antwerp and Ghent owe a large part of their development to their situation at the point of junction between maritime and fluvial navigation, and they have become foci of a network of waterways. The ports were important and prosperous before the advent of railways. These latter have certainly improved and extended communication with the hinterland, but they have not done away with the characteristics of Antwerp and Ghent as river ports.

At Antwerp, traffic with the hinterland is dealt with by river navigation to the extent of 50 per cent.; at Rotterdam the proportion is 90 per cent.; at Dunkirk it is only 10 per cent.

The navigable waterways, therefore, which converge on the Port of Antwerp are of the first order of importance. One of them, already alluded to and not the least important, is that which crosses the Campine to rejoin the Meuse at Liège. The Junction Canal between the Meuse and the Scheldt, completed by the Zuid-Willemsvaart and the canal from Liège to Maastricht, constitutes a route of penetration from Antwerp towards a hinterland of great industrial activity, viz., the basin of the Meuse, the Meuse Valley and Lorraine—a region of coal and iron. This route has been improved by the reconstruction of the canalisation of the Meuse in Belgian territory between Givet and Liège, in which the old locks have been replaced by more modern and large structures. In a short time, the Meuse will be navigable by boats of 600 tons, and even of 1,300 tons, capacity in the district of Liège. This great system of navigation had to be extended to the Belgian ports.

A canal broadly conceived, making, from an economic point of view, the Meuse to terminate at Antwerp has been incorporated in what may be termed the Meuse system and becomes its leading feature. This system of navigable waterways, of which the Antwerp-Liege Canal and the Meuse form the main axis, extends its ramifications to Eastern France. It crosses in its lower part the carboniferous basin of Limburg.

### Extension of the Campine Coal Market

Since 1918, Belgium has been exploiting a new coal field which considerably augments its resources in combustible fuel. The new coalfield occupies a zone 18 km. wide by 100 km. in length, measuring 1,800 sq. km. in area. The Southern boundary passes North of Lanaken, South of Genk and close to Geel. The northern boundary passes near Eelen, to the South of Maaseik, to Balen and Mol. This coalfield provides a coal reserve estimated at 8 milliards of tons. It is particularly rich in coking and gas-producing coal. So far it has only been partially tapped. It is worked to the East at the Eisden pit, situated on the edge of the Zuid-Willemsvaart; at the centre at the three pits at Genk: Winterslag, Waterschei and Gwartberg, and to the West, at the pits of Zolder and Beringen. Another pit, that of Houthalen, is being opened in the Western area.

Since the 1914-18 war, exploitation has been proceeding in accordance with a regular scheme of development.

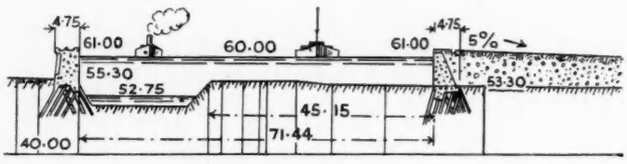
The Caster Cutting completed.

The canal from Mons to Condé, replacing the Haine; the Central Canal; the South branch of the canal from Charleroi to Brussels; the lower Sambre and the Meuse—these form the connecting links between the different parts of the old basin: Haine, Sambre and Meuse. It is at once clear that there is every inducement to prolong these waterways in the direction of the Campine coalfield, so that the Limburg mines may make good the deficiency in the former pits; so that the rich Campine seams used in mixture may allow of the transformation into coke of the poorer coal from the

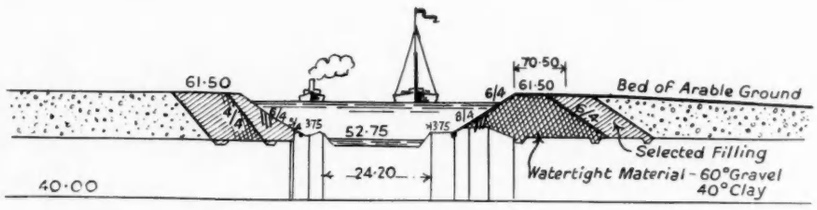
Compiled from, and mainly an abridged translation of, the work on the subject, written by Monsieur A. Delmer, Secretary-General of the Belgian Ministry of Public Works.

# The Albert Canal

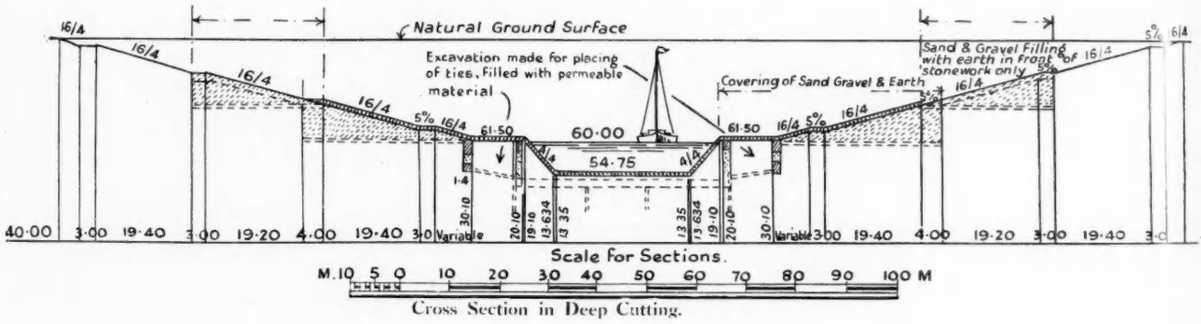
## Route Plan and Sections



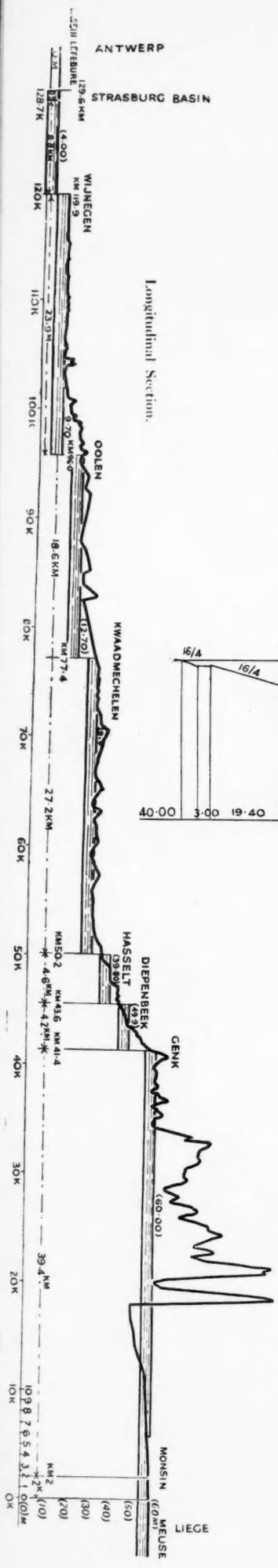

Cross Section in Lay-bye.

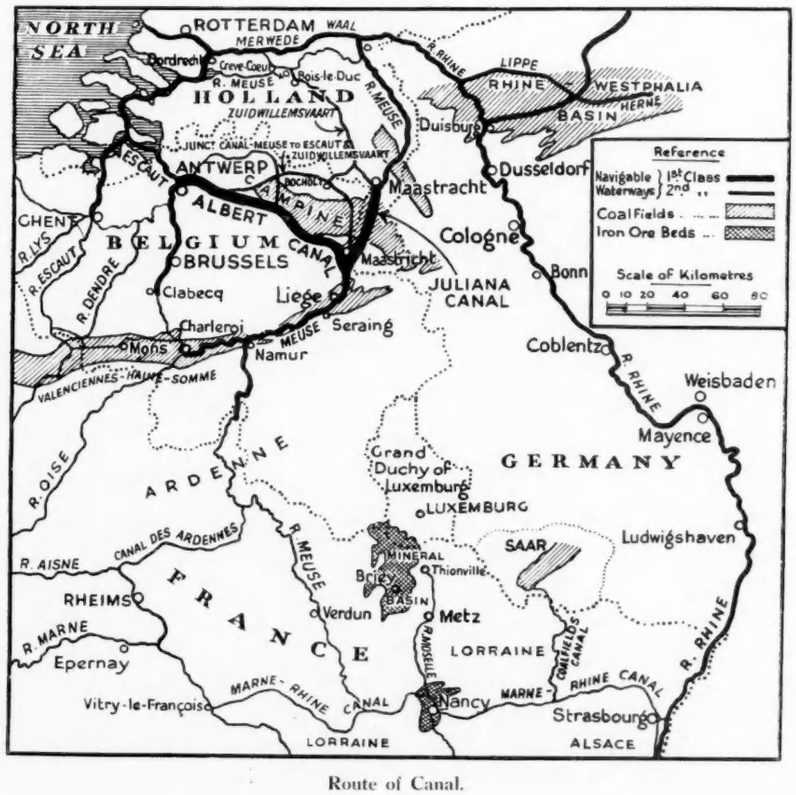



Cross Section in Embankment.




Cross Section in Deep Cutting.




Route of Canal.

## *The Albert Canal—continued*

Southern mines; and finally so that transportation facilities may be available for the rational use of native coal. Since, in fact, Belgian industries are, with few exceptions, located alongside waterways, it is fitting that the Campine coalfields, which supply them with fuel, should have been provided with a water frontage.

In order to extract the maximum output from the new coalfield, the waterway had to be up-to-date. The old waterways are too remote from the majority of the new pits to ensure cheap transport for the coal.

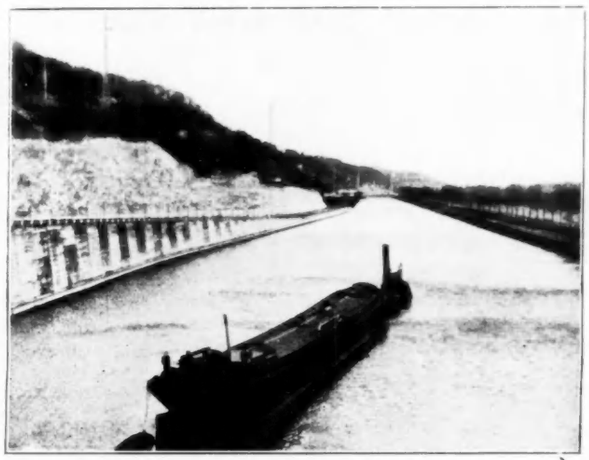
Every coalfield should have adjacent waterways: coal, a cumbersome product, consigned in large quantities and in bulk, is a commodity advantageously transported by boat.

The Belgian markets to be reached are at Antwerp, Ghent, Flanders and Brussels, where coke factories, gasworks, electricity stations and wholesale dealers have premises located at the water's edge and are in a position to take delivery by boat.

The large consumers of coal are to be found in the old coalfields where the seams are becoming exhausted and only produce a little coking-coal and gas-producing coal necessary for industrial purposes.

The rationalisation of the Belgian coal industry by abandoning the exhausted pits on the South and replacing them by new pits in the North can be achieved without difficulty, provided economical transport is available for feeding the centres of consumption from the Campine region. It is expected that the Rhenish craft, which transport Westphalian coal, will find alternative employment in the distribution of Campine coal.

A portion of the Belgian coal is available for export. Such export is both possible and advisable by reason of a waterway connection to the ports. Bunker coal can be sold at Antwerp and Ghent, whence it can be exported overseas.



The last Belgian Section of the Liège-Maastricht Canal.

The new pits will find an important outlet to the South, in the East of France and in Lorraine, where there will be a better market by reason of a waterway which permits of economic transport for the coal. The despatch, by boat, of coal to the North and the South will create favourable conditions for return cargoes, so assisting in the industrial development of the area adjacent to the mines. Thus the Albert Canal, flanking the South and West borders of the Campine coalfield, will fulfil a useful function in attracting industry to its banks. Fresh activities will spring to life in the Liège region.

### The Maintenance of Heavy Industries at Liège

Liège as the capital of a highly industrialised region, continues to flourish from the same causes as those which gave it birth. At the outset, the exploitation of the iron ore deposits in the Valley of the Meuse and in the Condroz, with the aid of forest timber and the utilisation of waterfalls, made the district of Liège one of the most celebrated centres of iron manufacture. Subsequent to the felling of the timber, the coal in the Meuse Valley between Liège and Seraing led to the establishment of some important foundries.

When the iron mines of the Ardennes were exhausted, it became necessary to seek supplies of ore in the Grand Duchy of Luxemburg. But smelting was maintained at Liège, near the coal pits between the iron mines of the South and the ports on the North.

At a later date, coking and gas-producing coal gave out and had to be sought in the northern coal beds. The Liège industrial situation became precarious. If the iron ore from the South failed, the last attraction which kept the metallurgic industry on the banks of the Meuse would disappear. This eventuality could happen through the depletion of the Lorraine deposits, and even in advance of this, should France desire to retain for herself the supplies of ore.

The decline of its metallurgy would be a disaster for Liège. In order to avert it, under the best possible conditions, the Albert Canal will henceforth discharge the essential function of linking up the Campine coalfield with the Port of Antwerp and so prove the salvation of Liège.

Moreover, there was the rivalry of the Netherlands route which tended to divert traffic to Rotterdam. The rejection by Holland of the proposed treaty in 1925 convinced public opinion in Belgium of the necessity of the solution of their problem on national lines.

The Vroenhoven Bridge.

### Selection of a Route for the Canal

After consideration of various geological and physical difficulties in the terrain, it was decided to adopt a route for the Albert Canal which follows the Meuse Valley along the old canal route from Liège to Maastricht, with a surface level of + 60 metres above sea level. Thence skirting as closely as possible the Netherlands frontier round the Maastricht enclave, it reaches the ridge of Eigenbilzen through the valley of Molenbeek. Leaving Eigenbilzen still at the same + 60 level, it approaches Genk, and is then diverted to the West to reach Hasselt and rejoin the branch canals towards that town. Between Hasselt and Antwerp, it passes by Beringen, Kwaadmechelen and Herentals, following the line of existing canals over a great part of the route.

The level of + 60 is maintained at Liège by means of the Monsin Weir. Since exceptional floods can raise the level of the Meuse above + 60 and it is undesirable for the canal level to exceed it by very much, a lock and a guard gate have been installed at the Island of Monsin. Normally, these are left in the open position, there being only a few days in the year when it becomes necessary to close the guard gate and put the lock in service.

The + 60 level is the same as that of the Geer at Canne, at the point where that stream enters Dutch territory, and also that of the foot of the Campine plateau at Genk. It was practicable to extend this level as far as the uppermost reach of the Albert Canal, and so to approach the coal pits at Genk. It would have been difficult and unnecessary to prolong it any further.

The canal descends rapidly from Genk to Hasselt: 30 metres in 10 km., because in order to rejoin the extremity of the branch canal to Hasselt, it is necessary to cross on the skew the North slope of the Démer Valley.

The branch canal to Hasselt, extended beyond Turnhout, represents a reach of 80 km., including its annexes, all at + 30 level.

Between Kwaadmechelen and Herentals, the ground surface slightly exceeds the + 30 level, then descends to + 20 and even lower, in the valley of the Great Nethe. At Herentals, the level is about + 10 and it gradually falls to sea level at Antwerp. At Wijnegem, the ground is sufficiently low to permit of the canal level being + 4 as far as the Antwerp docks.

The Canal between embankments at Lanaye.

Between the highest reach at the + 60 level, prolonged as far as Genk and the lowest reach (Wijnegem, Antwerp) at + 4, there is, therefore, a fall of 56 Metres. In view of this fact, the canal has been subdivided into 7 reaches, with 5 sets of locks, each of about 10 metres drop and a final lock of 3.70 metres fall.

It has been arranged to have a uniform amount of fall in order to offset the feed water in the different reaches; it has also been contrived that the reaches shall be sufficiently long as to moderate the loss of level due to lockage operations. It was found impracticable, by reason of the land contours, to increase the length of the reaches between Genk and Hasselt, so the canal in that section has been given much greater width to compensate for the inadequate length.

## *The Albert Canal—continued*

The division of the canal into its several reaches is set out in the following table:—

| | Amount of Fall metres | Water Surface Level metres | Length of Reach Kilo-metres |
|---|---|---|---|
| From the river Meuse to the lock at Monsin | | 60.00 | 2.0 |
| Monsin Lock ... ... ... ... ... | 0 (normally) | | |
| From Monsin Lock to Genk ... ... ... | | 60.00 | 39.4 |
| Genk Lock ... ... ... ... ... | 10.10 | | |
| From Genk to Diepenbeek ... ... ... | | 49.90 | 4.2 |
| Diepenbeek Lock ... ... ... ... | 10.10 | | |
| From Diepenbeek to Hasselt ... ... ... | | 39.80 | 4.6 |
| Hasselt Lock ... ... ... ... ... | 10.10 | | |
| From Hasselt to Kwaadmechelen ... ... | | 27.70 | 27.2 |
| Kwaadmechelen Lock ... ... ... ... | 10.00 | | |
| From Kwaadmechelen to Oolen ... ... | | 19.70 | 18.6 |
| Oolen Lock ... ... ... ... ... | 10.00 | | |
| From Oolen to Wijnegem ... ... ... | | 9.70 | 23.9 |
| Wijnegem Lock ... ... ... ... ... | 5.70 | | |
| From Wijnegem to Antwerp (Strasburg Basin) | | 4.00 | 8.8 |
| Strasburg Basin to Lefebre Basin ... ... | | 4.00 | 0.9 |
| Total | 56.00 | | 129.6 |

The above arrangement was adopted as comforming as closely as possible with the conformation of the route. It will be seen that it involves only 6 changes of level in a distance of 130 kilometres.

The Weir at Ramet-Ivoz on the Meuse.

Modern technique admits of the construction of locks with falls greater than 10 metres. It would have been possible to have had only 4 changes of level: 3 of 15 metres and 1 of 11 metres. The idea was discarded, because the consumption of water for lockage might have exceeded 50 per cent., the constructional cost of the locks would have been much greater, and the amount of earthwork more considerable. These drawbacks would not have been adequately conpensated by the saving of time in transit, nor by the reduction in operation expenses.

### Traffic Capacity and Traction

The Albert Canal can accommodate craft of 2,000 tons burthen, which occasionally offer themselves for passage. It is the standard tonnage of the canalised Meuse and of the Juliana Canal. More frequently, the dimensions to be completely met are those of the Rhine boats of 1,350 tons which easily navigate the Meuse in the region of Liège, and will even in the near future be able to reach Huy.

The profile section adopted for the canal has a central axis depth of 5 metres, with 4.70 metres at the sides, and a depth of 2.50 m. for a width of 30 metres with 151 sq. m. of water sectional area. Boats of 1,350 tons capacity can pass at full speed. The sectional ratio being 6.4, the tractive effort remains low.

The foregoing is the minimum sectional profile. It is frequently exceeded, even considerably, in the three long reaches. In curves, the radius of which does not fall below 1,200 metres, an increased width is given to the waterway.

The Albert Canal does not claim to be a ship canal, although small coasting vessels, such as those which navigate the Rhine can make use of it. It is possible for regular and direct services to be established between Liège and the North Sea and the Baltic for ships of this class with tonnages between 300 and 800.

From experiments on models carried out by Professor Bogaert and his assistant, Mr. Boulanger, it has been demonstrated that a tractive effort of 1 kilogramme per ton of displacement in a boat fully laden permits of a speed of about 7 kilometres per hour.

The sectional profile of the canal is comparable with that of large canals for inland navigation. It is as capacious as that of the Juliana Canal; it exceeds those of some of the most recent German canals.

The profile has been designed to ensure stability in the side slopes, even in the treacherous ground of the Campine. The slopes are 20 to 4 and 16 to 4. A good depth has been given to the canal on account of its influence on the ease of transit of boats and to avoid any serious consequences arising from an accidental lowering of the water level.

A berm, or ledge, 2 metres in width, at a depth of one metre below water surface level serves to diminish the effect of wave action and protects the embankment. Above the berm, the bank is generally protected by dressed masonry, or by concrete slab-work, resting on a concrete block supported in places by piles. Above the water line, the slope is covered with turf.

The impermeability of the waterway is secured, wherever necessary, either by a layer of mixed clay and gravel or by a layer of concrete.

### The Locks

Each reach of the canal is controlled by a set of three parallel lock chambers: two large and one small. The former with dimensions of 136 m. by 16 m. with 4 m. depth over sill, are for the service of the large Rhine boats, singly, as also for moderately-sized and small boats worked in trains of 3 or 4 by means of tugs.

The "spits" and the Campine craft, travelling singly, with automotor boats, "bateaux porteurs," "beurts" and yachts use the small chamber (55 m. by 7.50 m.).

The dimensions of the large chamber locks correspond to those on the Juliana Canal, with this difference that the lock gates of the Albert Canal are the same width as the lock chamber, whereas those of the Juliana Canal are 2 metres less than the width of the chambers.

Whatever type of boat be employed, whether in single units or in trains, it is possible to pass through a large chamber in one direction and by a single operation, 2,000 tons of merchandise and through the small chamber, 600 tons. The set of three chambers has therefore a theoretical capacity of 4,600 tons per operation. For a two-way passage, this is equivalent to 9,200 tons. Assuming a single complete double operation on each of 300 days in the year, the annual traffic volume would be 2,760,000 tons.

The gates are metallic and of the mitred type, this having been considered, for the large differences in level, the less costly and the more robust. At the downstream end of each lock, the gates are 15.25 m. in height and at the upstream end 4.50 m. and 5.25 m. In the large chambers, the width is 9.10 m. and in the small chambers, 4.05 m. The downstream gates of the large chamber gates weigh about 50 tons per leaf.

The magnitude of the work involved in each set of locks can be gauged from the following figures:—

| | |
|---|---|
| Earthwork | 4 to 500,000 cu. m. |
| Concrete | 110,000 cu. m. |
| Iron and Steel | 2,000 tons |
| Dressed Masonry | 500 cu. m. |
| Rubble Masonry | 4,300 cu. m. |

### Canal Bridges

There are 65 bridges across the canal, equivalent to a bridge every 2 kilometres.

The Strasburg Basin at Antwerp.

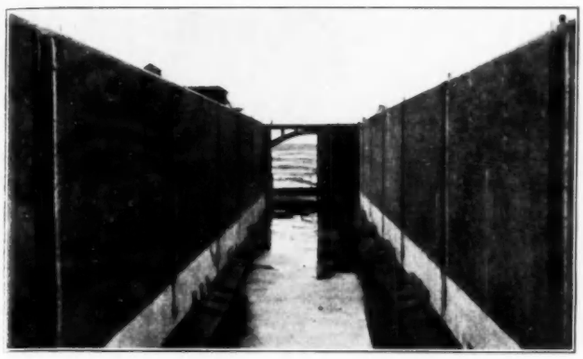
In the parts where the new canal supersedes the old work, it has not been possible to provide bridges at all places where they existed previously. Ten swing bridges in the section from Liège to Maastricht between Wandre and Haccourt have been replaced by four fixed bridges. In only exceptional cases have existing bridges been retained.

Of the new metallic bridges, a number have been constructed with welded, instead of rivetted, joints. Unfortunately in March, 1938, the bridge at Hasselt which was of the all-welded type, collapsed and had to be rebuilt. The cost of the new bridge, however, was much less than the economy which has resulted from the employment of this type of bridge on the canal.

## *The Albert Canal—continued*

### The Ports

At Liège, the port area is formed by the entire industrial section of the Meuse comprised between the weirs of Ramet-Ivoz and Monsin. This provides a quay frontage of about 45 kilometres, of which the greater part is available for private and public purposes.



Lock at Kwaadmechelen. View of downstream gates.

Downstream of Liège, there is the port of Monsin, consisting of two basins, 70 m. wide and 425 m. and 500 m. long respectively. One or two supplementary basins may be formed later. This port is connected with the railway by a line starting at Bressoux and crossing the Meuse a little below the Monsin Weir. It is considered that there is a prosperous future for the Port of Monsin by reason of its favourable situation in the Northern part of the town of Liège.

In Liège itself, there are numerous port installations in commission, extending over a length of 1,524 m. of quay. These installations have been entrusted by the Belgian Government to a body called The Autonomous Port of Liège, consisting of an equal number of representatives of the State and of the City. Independent of this public administration, there are a number of industrial quays in the hands of factories and coal mines. The great industries of Cockerill, of Ougrée and of Espérance-Longdoz have already constructed, or have in prospect, berthage quays with high capacity appliances for craft of 1,350 tons.

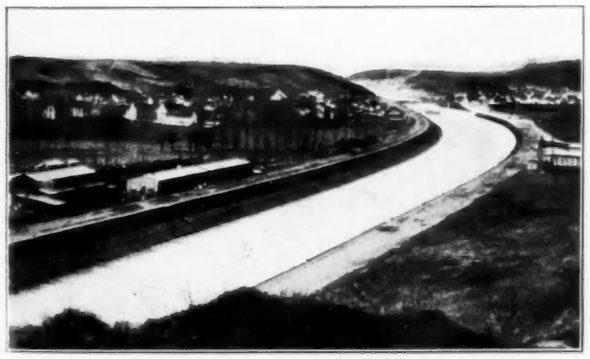
Mention must also be made of the commercial port of Jemeppe, installed in a basin, and the basins of refuge of Seraing and of Ivoz-Ramet.

The whole industrial area of the Port of Liège has a movement of goods of more than 2 million tons. With the exploitation of the Albert Canal, this will be considerably augmented.

At Antwerp, the fluvial and the maritime ports are intermingled. The Looibroek, formerly a fortification ditch, has been transformed into a fluvial port connected to the railway. The Commune of Merksem operates a basin which branches from the north bank of the Albert Canal.

The extremity of the old branch canal towards Hasselt has been transformed so as to continue to serve as a basin accessible to the railway.

There are, moreover, certain coaling basins of importance at Genk, at Zolder and at Beringen, where basins have been formed and equipped with coaling appliances.



The Canal in the Geer Valley.

### Some General Statistics

The length of the Albert Canal, measured between the Monsin Lock at Liège and the entrance to the Strasburg Basin at Antwerp, is 126.7 kilometres. The distance by rail from Liège to the Port of Antwerp is about 125 km. By the old canal route, the distance was 155 km. As the crow flies, the distance is about 110 km.

The duration of the trip by boat depends not only on the length of route and the speed of embarkation, but also on the number of lockings, because each of these occasions delay.

Four boats in train drawn by a tug can navigate the Albert Canal at a speed of 6 km. per hour. A similar train of boats will only be delayed half-an-hour in passing through a single lock, which is equivalent to an increase in the passage length of 3 km. For the six locks, the virtual length is increased by 18 km. and the virtual length of the whole route becomes 145 km. The duration of the trip from end to end can be put at 24 hours 10 minutes, corresponding to two days in summer and 3 days in winter, on the assumption of a 12-hour navigational day in the former case and an 8-hour day in the other.

On the old waterways a similar train of boats travelled at the rate of 4 km. per hour with a delay of 100 minutes at each lock. The mean duration of a trip was actually 16 days due to various obstacles.

The following table summarises and extends the foregoing information:—

| | Former Canal System | Albert Canal |
|---|---|---|
| Length in kilometres ... ... ... ... ... | 155 | 126.7 |
| Number of Locks ... ... ... ... ... | 23 | 6 |
| Average speed in kilometres per hour ... ... | | |
| For a train of 4 boats ... ... ... ... | 4 | 6 |
| For a single automotor boat ... ... ... | 5 | 9 |
| Delay in minutes for the passage of a single lock ... | | |
| For a train of 4 boats ... ... ... ... | 100 | 30 |
| For a single automotor boat ... ... ... | 30 | 20 |
| Length of Route in kilometres equivalent to the passage through a lock ... ... ... | | |
| For a train of 4 boats ... ... ... ... | 6.7 | 3 |
| For a single automotor boat ... ... ... | 2.5 | 3 |
| Virtual length of Route in kilometres ... ... | | |
| For a train of 4 boats ... ... ... ... | 308 | 145 |
| For a single automotor boat ... ... ... | 212 | 145 |
| Duration in hours of the trip, Liege-Antwerp ... | | |
| For a train of 4 boats ... ... ... ... | 77 | 24 |
| For a single automotor boat ... ... ... | 42½ | 16 |
| Duration in days of the trip, Liege-Antwerp ... | | |
| For a train of 4 boats ... ... ... ... | 6 to 10 | 2 to 3 |
| For a single automotor boat ... ... ... | 4 to 6 | 1 to 1½ |

The total cost of the undertaking, computed at the time of the opening of the Liège Exhibition in May, 1939, when the works were not actually completed, was "2 milliards of francs." The francs referred to were of different values on the gold standard and the actual payment value is given as 235 millions in gold francs. The work was inaugurated, on 31st May, 1930, by the late King Albert, and the canal was opened to traffic throughout on Christmas Day, 1940.

## *Navigational Improvement of the River Paraguay*

### *International Agreement on Dredging and Buoying*

A treaty has recently been signed by Dr. Guillermo Rothe on behalf of the Argentine Republic and Dr. Luis A. Argano on behalf of Paraguay, establishing the basis for navigational improvements to be carried out in the Rio Paraguay, comprising the dredging of the river channel and the demarcation of the fairway by means of buoys. The following is a summary of the chief stipulations of the treaty, which contains seven Articles:—

Article I establishes the minimum depth of water to be maintained at 6-ft. or 1.83 metres. For dredging purposes, the river, as between its point of confluence with the Rio Parana, will be divided into three distinct stretches, namely: (a) from the point of confluence with the Rio Parana to Formosa; (b) from Formosa to the mouth of the Rio Pilcomayo! and (c) from the mouth of the Rio Pilcomayo to Asuncion. According to Article II. the dredging operations and the cost thereof over section (a) will be undertaken by Argentina; that of section (b) will be carried out by the Argentine Government with Argentine equipment, and the cost thereof will be equally divided between the two Republics; while section (c) will be the exclusive responsibility of the Paraguayan Government.

In order to preserve the greatest possible degree of uniformity of procedure in the marking of the navigable fairway of the river, Article V provides that the laying of buoys and the cost thereof, between the point of confluence with the waters of the Rio Parana and the mouth of the Rio Pilcomayo, will be undertaken exclusively by the Argentine Government. Each country will have the right to place necessary navigation signs and marks on the coast of the other. The Agreement will enter into effect the day following ratification and will continue until one year after either party shall have announced its intention to terminate the arrangement.

# *Notes of the Month*

**New Floating Dock for Canada.**

A contract has been let for the construction of a new floating dock to cost between 2½ and 2¾ million dollars for use on the Canadian East Coast. Completion is not expected before 1942.

**Humber Graving Dock Company.**

The accounts of the Humber Graving Dock and Engineering Company, Ltd., for the twelve months ended June 30th last, show a profit on ship repair and other work of £49,175, as compared with £14,251 in the previous year.

**Penzance Harbour Revenues.**

The chairman of the Finance Committee of the Penzance Town Council (Alderman T. Jackson) has announced that the harbour undertaking during the past year lost revenue to the extent of £2,300.

**Dublin Port Appointments.**

Lieut.-Commander A. J. O. O'Brien-Twohig, assistant harbour master at Dublin has been appointed acting harbour master in succession to Captain J. H. Webb who has retired. Mr. F. W. Bond, assistant engineer-in-chief at the port has been appointed acting engineer in succession to Mr. Joseph Mallagh the former engineer-in-chief, who has retired.

**Cocoa Port Improvements.**

A contract has been placed for the construction at the Port of Cocoa, Florida, U.S.A., of a 27-ft. channel leading to a harbour and turning basin, the last-named being 27-ft. deep and 1,000-ft. wide, with lengths of 2,900-ft. on south side and 900-ft. on north side. Provision is also being made for piers, warehouses and transit sheds and various items of port equipment.

**Lighting of British Port Approaches.**

Replying to a question recently in the House of Commons, the Civil Lord of the Admiralty said that every endeavour is being made to maintain sufficient navigational aids for British shipping in port approaches, so far as is possible in avoiding asistance to the enemy. He regretted that it had not been possible up to the present to overcome all the practical difficulties in the way of substantial improvement.

**River Wear Commission.**

Alderman Frank Nicholson has been re-elected chairman of the River Wear Commission and Mr. T. W. Greenwell, vice-chairman. In his address at the annual meeting, Alderman Nicholson alluded to negotiations between the Commissioners and the Corporation of Sunderland and stated that "they had fortunately reached a stage of affairs when the Corporation sees eye to eye with the Commission on the importance of maintaining the trade of the Port."

**Proposed Riverfront Reconstruction at New York.**

A proposal is under consideration for the purchase, or lease, of certain water front piers in Hoboken, Port of New York, by the Bethlehem Steel Company, who contemplate modernising them and constructing dry docks and repair yards which will be capable of giving employment to between 4,200 and 6,000 men daily. The piers, now government-controlled, were formerly owned by the Hamburg-America and North German Lloyd Steamship Companies.

**Southampton Harbour Board.**

At the recent annual meeting of the Southampton Harbour Board, Mr. Harry Parsons was re-elected for the 18th time to the chairmanship. Sir Sidney Kimber was re-elected deputy chairman, a position he has occupied for 13 years. In acknowledging his re-election, Mr. Parsons said the Board was now going through deep and troubled waters, but that could not last for ever and members could look forward to happier times. Their difficulties, however, would not end with the conclusion of the war.

**Belfast Harbour Finances.**

The report of the auditors at the adjourned annual meeting of the Belfast Harbour Commissioners, held under the chairmanship of Sir Ernest Herdman, D.L., certified total receipts for the year ended 31st December, 1940, to be £349,940 7s. 4d. which, compared with the previous year, showed an increase of £8,105 18s. 4d. The total expenditure, inclusive of depreciation, transfers to Insurance Fund, Sinking Fund and Statutory Borrowing Bank Account, amounted to £329,380 7s. 9d., an increase of £12,421 3s. 4d. There was a surplus for the year of £20,559 19s. 7d., being a decrease of £4,315 5s. 0d. The report was adopted on the motion of Sir Thomas Dixon, Bt., seconded by Mr. J. Milne Barbour, Northern Ireland Minister of Finance.

**The New Dry Dock at New York.**

The contract for the new 1,200-ft. graving dock to be constructed at Bayonne, in the Port of New York, was placed early in March and the work is expected to be completed late in 1942.

**Mersey Docks and Harbour Board.**

Major Roland Hobhouse Thornton has been appointed an elective member of the Mersey Docks and Harbour Board to fill the vacancy caused by the death of Sir Richard D. Holt.

**Copenhagen Harbour Traffic.**

A Report issued by the Copenhagen Harbour Authority shows a considerable decrease in traffic during 1940 as compared with 1939, the shipping entries being 10,112 and 23,744 respectively. Tonnage was decreased by 50 per cent.

**New Southampton Port Manager.**

Mr. H. A. Short, assistant docks and marine manager of the Southern Railway, has been appointed acting Docks and Marine Manager at Southampton, while Mr. R. S. Biddle is serving as deputy director of ports under the Ministry of Transport.

**Hudson River Channel.**

The deepening of the channel in the Hudson River to the Port of Albany, New York State, U.S.A., being three-fourths completed, the Corps of Engineers of the U.S. Army is recommending the completion of the section of the work between Albany and Waterford.

**Montrose Harbour Appointments.**

Mr. W. P. Martin has been appointed Harbour Clerk and Treasurer, and Shore Dues Collector at Montrose in consequence of the relinquishment of office by Mr. L. S. Smith, former Collector of Shore Dues, who has had 67 years service with the Harbour Trustees. The Harbour Master, Capt. Jas. Cobb, has also retired and been replaced by Mr. John Neish as Dockmaster.

**Port Amalgamation in Japan.**

The Japanese Government have decided that the ports of Tokyo and Yokohama, which are closely adjacent, shall be merged and the joint port is to be known as Kelhin or Tokyo Yokohama port. In a division of interests, Yokohama will take the foreign shipping trade and Tokio, that of the "Yen Bloc" areas.

**Stevedoring at the Port of Stockton.**

The Port Commission of Stockton, California, U.S.A., announce that they have acquired the stevedoring equipment and gear of the Stockton Terminal and Stevedore Company at present working in the port, with the intention of rendering port cargo-handling services where they may be desired, without interfering with the operations of private stevedoring firms.

**Additional Grain Storage at Port Arthur.**

Two new storage buildings for grain cargoes have been arranged jointly by Saskatchewan Manitoba and Alberta Wheat Pools. The buildings will have a combined capacity for ten million bushels of wheat. They form an instalment of a gigantic fifty million temporary storage scheme under the Federal Government, arising out of the surplus production of wheat in the prairie provinces and war-time curtailment of the normal market.

**South American River under International Control.**

The agreement between Argentina, Bolivia and Paraguay for the regularisation of their respective and joint interests in the waters of the Rio Pilcomayo deals with such diversified aspects as canalisation, navigation, fishing rights, irrigation and the use of the Rio Pilcomayo waters for industrial purposes. It provides for the appointment of a special mixed committee, each country to be represented thereon by one member. The task of this committee will be to study the subject matter of the Agreement and draw up a project of agreement to be submitted to the three Governments concerned.

**Creation of New Dublin Port Stock.**

The Dublin Port and Docks Board have decided to create a further £130,000 of 4 per cent. stock. The object of the additional capital, it is stated, is to finance the reconstruction and modernisation of the Custom House Quay, the scheme for which includes the deepening of the river at that point, so that, when completed, it will be possible for Continental-going ships to discharge cargo at the berth. Improved shed accommodation will also be made available. By the raising of capital at this juncture in order to undertake the work, the Board will be enabled to retain in their employ a number of men of long service who would otherwise, owing to their redundancy, have to be discharged.

# Beach Erosion and Coast Protection

*An Address by J. SPENCER SMITH, President, State of New Jersey Board of Commerce and Navigation; President, American Shore and Beach Preservation Association**

### Beach Influence on Ports

Beach Erosion and Coast Protection, on the whole, have a direct bearing on the development and welfare of our ports. Offhand, this may sound like a far-fetched statement, but even a cursory analysis will demonstrate the principle.

A river port, like New Orleans or Montreal, is too far inland to be seriously affected by the shoaling that might occur where the river flows into the sea, although the construction and maintenance of the passes at the mouth of the Mississippi River and ample proof that, even there, the river port is not always free of the shoaling problem. Ports like Long Beach and Los Angeles, however, are confronted by the shoaling of the inlets to their harbours, due in most cases to erosion of adjacent beaches.

Ports are generally concerned with the costs of deepening and maintaining entrance channels. The depth and width of the channel frequently govern the growth of the port. Ports usually take pride in telling the world about the depths of the fairway leading to their wharves. The owners and captains of vessels have greater confidence in a port or harbour which possesses deep and stable channels. This, in turn, results in these agencies of international commerce becoming boosters for such ports which are free from navigation perils.

When beaches adjacent to a channel are eroded, the sand movement, unless arrested by natural or artificial forces, will produce shoaling and shifting of the channel. The more nearly uniform a channel remains, the more attractive it becomes to shipping interests and the less costly it is to maintain.

Jetties erected at the mouths of rivers and inlets, while serving the purpose of lessening the cost of channel maintenance, are sometimes the cause of beach destruction. The elimination of the sandy beach depreciates adjacent land values and sometimes has a bearing on the direction and force of offshore currents. At this time no one can speak with confidence on the question of currents as they affect the beaches, nor has any one solved the complete control of littoral drift.

It is natural and human to think and act about what most concerns us. I am quite confident that, if the Board of Commerce and Navigation of New Jersey had jurisdiction only over commercial harbours and ports, we would have little or no knowledge of the relationship between ports and beaches. It happens that this Board is charged with the duty of promoting the welfare of the Jersey waterfront, whether such waterfront be dedicated to commercial and shipping purposes or used wholly for pleasure and beach resorts.

Probably no public agency has had a better opportunity to observe the unfortunate consequences of a lack of plan and control of a waterfront than has the Jersey Board. Prior to 1915, at which time the Board of Commerce and Navigation was created, no state agency had authority to administer and regulate our shore fronts. We are trying to correct the failures of the past, but the progress is necessarily slow.

### Value of Waterfronts

I mention all of this to you because every state bordering on a navigable river, lake, or any waterway, should have a State Board clothed with the power the Jersey Board possesses to look after the State's interest. A waterfront is a priceless heritage. It can be so utilised as to add greatly to the economic development of a community, enhance the beauty of its shores to a high degree, and, further, profitably contribute to the pleasure of its inhabitants. The knowledge of how to plan and properly utilise a waterfront is something that can be acquired only through the hard school of study and experience.

It seems to me, sometimes, that we of the American Association of Port Authorities think of ports only in connection with ocean-going ships. You remember what Captain Coffman had to say about the assistance given to the Navy in 1912 because of the men in the fleets, and I think that has a bearing to-day; that is, the number of people engaged in boating through the use of these small boats. I know my own boy got hold of a water cruiser here just a short time ago. He never had had any experience on the water prior to that and yet he can handle it just like a veteran, he can handle the helm and operate it just like if it were an automobile. I am certain if he were to-day called to the Navy, because of that experience with the cruiser, he could serve very much better than anyone who has never had any experience in the water or the handling of water craft. If we can build up a great army of young men familiar with water craft, in the handling of them, the rules of the sea, the rules of navigation, it will be of great assistance in time of need. In recent years the small boat industry has grown with great rapidity. People within reasonable driving distance of the waterfront are purchasing cabin cruisers for pleasure and fishing purposes whenever harbours and accommodations are found which will protect their craft from stormy seas.

This is what might be termed an infant industry. These pleasure craft are the forerunners of commercial activities. In their wake frequently follow fishing, boat building, the movement of oil, gasoline and bulk commodities by water.

### Utility of Beaches

A port is fortunate if its entrance channels are surrounded by beaches. The hazards of navigation are thereby lessened, especially in stormy or foggy weather. A good illustration of this fact is the Port of New York. It is flanked on the north by the Long Island beaches and on the south by the Jersey beaches. Large vessels have been driven ashore but in every instance have been refloated and have resumed service. That is a very important point that people forget. You take wherever a harbour has a rocky shore, approaching in foggy weather, of course, it is always dangerous to the ship. The Port of New York in the past—not too frequently to-day, on account of the radio and one thing and another—we have had some of our large ocean liners go ashore either on the Jersey shore front or the Long Island beaches, and in each case they have been pulled off and put back into service again.

Fortunately for the Port of New York, the littoral drift in its vicinity has not caused any material deposit of sand in its entrance channel. The channels thus far have required comparatively very little maintenance. This may be due, in some measure, to the steps taken in recent years by both the New York and New Jersey authorities in attempting to control the sand movement along their respective shore fronts.

Beach erosion and shore front protection have a further claim upon the attention of port authorities; namely, interest on your part in the preservation of our beaches would enlist popular support for your own port projects. You know, " Frosty," as we call him, talked about oil. Notwithstanding the oil, notwithstanding everything else here in Long Beach, it is a resort community. Well, I want to tell you that the population of a community is interested in beaches. They are not interested in ports. If you can get the population with you, you can also get the money for the port projects.

### Seaside Amenities

It is difficult for the average man to visualise any connection between the expenditure of thousands of dollars to serve shipping interests and the direct economic and financial returns to himself. He associates shipping interests with " economic royalists " and fails to recognise the enhancement of the commercial growth of his city and state, the lowering of transportation costs and the consequent lowering of the cost of living. If you link up your waterfront problems, you unite the social enthusiasm of the worker and the self-interests of commerce; and, above all, you promote the welfare of young and old alike by affording them the enjoyment of invigorating sunshine and sea breezes. I don't know anywhere where that is more eloquently—if you can use that word—illustrated than right here at Long Beach where you can see them disporting themselves, having a grand time, the band playing, and then just a little bit to the north, whichever way the direction is here, why you have the port with all its facilities. Co-ordinating and integrating these several and diversified groups spells success in the upbuilding of any community. It was the late Calvin Tomkin, one of the founders of our Association, who, while Dock Commissioner of New York, demonstrated the wisdom of linking up welfare work with commercial activities. The City of New York had provided band music in the summer time for certain outdoor locations. Mr. Tomkin secured a band for one of the open piers. When the City prepared its annual budget, Mr. Tomkin found the appropriation for his department substantially cut. The voters of that particular waterfront district registered such a vigorous protest that the appropriation requested by Mr. Tomkin was restored.

We know that men holding political office frequently curry the favour of the public and will respond to requests or appeals largely in proportion to the number of votes at stake. If you need help, enlist the masses on your side.

The benefits derived from beach protection and the co-ordination of that undertaking with the problems of a commercial port have been pointed out. There remains, however, the problem of the physical, financial, and legal means to accomplish such protection and to preserve our beaches.

### Beach Protection and Preservation

These three phases have still to be dealt with. The engineering difficulties are being overcome and excellent progress is being made in this direction largely through the work of the U.S. Beach Erosion Board. Much remains to be learned, however. Given sufficient time and money, our engineers, with the aid of the geologists, will be able to build structures which will safeguard and protect our shore lines from the ravages of the seas. Generally, beaches undisturbed by the works of man will " come and go." A storm will erode a shore front and a storm from another direc-

*Delivered at the 29th Annual Convention of the American Association of Port Authorities, 1940.

## *Beach Erosion and Coast Protection—continued*

tion will restore the beach. Before homes and developments along our shore became popular, sand dunes and broad stretches of sandy beaches provided sources for the replenishing of the sand carried away by wave action. Beaches, however, must be fed just as human beings must be nourished. The automobile has changed the situation. With the splendid roads that now connect the hinterland in all directions with the shore front, more and more people have come to use our beaches and developments frequently occupy the foreshore to the very edge of high water. This occupancy does not permit the sufficient area which Nature demands to retrieve sand for accretion in places where erosion has occurred. Just as we now have air-conditioned homes and buildings in order to offset adverse weather conditions, so we shall be compelled to adjust man's desire for beach occupancy to the demands of Nature.

The financial problem is of great concern to us. In other words, from what sources can be drawn the necessary funds. The preservation of beaches calls for the expenditure of large sums of money. In this connection, it is right that the beneficiaries of beach protection and of its enjoyments should participate in the financing of the necessary works. A survey should be made to determine whence come those who use the beaches and enjoy the benefits thereof. The cost should then be apportioned in the ratio of benefits derived by the various interests involved; namely, the local community, the county, the state, and the nation. This will take time and require patience and perseverance. Let us not forget that this problem has become a pressing question only since our country has become a nation on wheels.

The legal phase of the problem is mentioned last but, in the end, it will probably prove the most troublesome question. The legal snarls encountered in the restoration of beaches are nothing new, but our laws are inadequate to deal with them. As an illustration, let us take the case of a community which has the financial resources to erect and does erect ample structures to protect its shore front. The adjacent community is not so favourably situated financially and is unable or unwilling to erect the structures. The works of the first community cause the beaches of the second community to starve and irreparable injury to the latter follows. The question arises as to responsibility for damages suffered and as to the legal right in the first place of the offending community to construct the structures without proper authority from some governmental body vested with such authority.

In travelling around the country and talking with people, I have found a general feeling that the responsibility of protecting our shore lines is a public one; the people feel that some governmental agency should have the job. The average critic fails to understand that most waterfronts are privately owned.

Because of the nation-wide feeling that, regardless of the ownership of the land bordering on our waterfront, the people have the right to enjoy the beaches, we should accept as fundamental the principle that a governmental body should be clothed with power to deal with the many phases of the problem of beach preservation and restoration.

The American Shore and Beach Preservation Association was formed for the purpose of gathering and disseminating information about these problems. It would be most helpful if we could have the active support and co-operation of the members of this Association. Our work is correlated. We are both endeavouring to serve the public. We can do so best by the proper co-operation between the two associations.

### Discussion.

**Mr. M. W. Oettershagen,** Harbour Engineer, of Chicago, Ill., said: This timely and interesting paper comes from one well qualified in the subject. Anyone even moderately alert has been impressed with the wide gains in popularity of outdoor bathing and swimming during the past 30 years. This writer has seen the development of beaches in his own city grow from one mile to 24 miles during that time. Where hundreds used the beaches a generation ago, tens of thousands make use of them now. The development of the automibile, construction of good roads and the lure of the outdoors have made nomads of the American people and in nearly every trip and every vacation a stop at some waterfront or beach is included in the itinerary. It may be truly said that the American public is waterfront conscious.

Shortly after the first gains in beach popularity came a realisation of the inadequacy and limitations of the private beaches. The public demand required additional facilities and this trend soon went beyond the scope of private enterprise. With the development of additional beaches for recreational uses came all the other attendant beach problems. The scope of the problems advanced from a locale to a region, thence to a whole state and finally to the nation. Thus the priceless asset of our beaches have become a Public Trust. They should remain a Public Trust. The days of private occupancy and usurpation of beaches is a thing of the past. Henceforth beaches are to be public property and improved, developed, protected and administered by the public in a manner calculated to produce the greatest possible benefit to our people.

Nor is bathing or swimming the only use and benefit to be derived from beaches. In many cities situated on ocean, river, lake or bay the common practice is to set aside large sections of waterfront for park purposes. In Chicago, for example, of the 25 miles of frontage on Lake Michigan within the corporate limits of the City, there has been reclaimed for the public a frontage of 20 miles for park purposes. Three of the remaining five miles are planned to be acquired by the public for park purposes, leaving two miles for commercial and industrial port development. Within the parks are provided adequate bathing facilities conveniently spaced, yacht harbours and anchorages and promenade wharfage.

The speaker makes reference to the uniting of recreational and commercial interests in sponsoring a development. Again we may draw on the experience at Chicago where the proposed expenditure of four million dollars for a commercial pier lagged in materialisation until a recreation section was added. This recreation section has continued to be popular in the 26 years of the history of the Navy Pier.

This writer believes that much greater emphasis should have been made of the part taken by "The American Shore and Beach Preservation Association." The writer was present at the formation of that Association in Asbury Park, New Jersey, in the fall of 1926. At that time the Governor of the State of New Jersey had invited the Governors of other tidewater states to send representatives to meet at Asbury Park to discuss the beach problem. The attendance was fair and indicated a general need for investigation of the beach problem and the Association mentioned was founded. It was apparent that although certain far-sighted engineers and officials saw the need for concerted action, the ideas advanced and the meagre technical observations made demonstrated the complete lack of reliable information on the subject.

**Mr. Gerald C. Fitzgerald,** Consulting Engineer, Los Angeles, California, said: Mr. J. Spencer Smith is to be commended on his excellent paper on Beach Erosion and Coast Protection. As President of the Board of Commerce and Navigation of New Jersey and the American Shore and Beach Preservation Association, Mr. Smith and the organisations that he has been affiliated with for so many years have made outstanding contributions to beach protection and development. The report by the Board of Commerce and Navigation of New Jersey on the erosion and protection of the New Jersey beaches in 1922 lead the way to a clearer understanding of general engineering principles of coast protection and beach protective devices, and stressed the importance of the protection of the New Jersey beaches and their tremendous value to the state and nation at large.

The American Shore and Beach Preservation Association have in a large measure been responsible for the systematic organised effort that has and is being made to learn about the forces affecting Beach Erosion and Coast Protection, and in educating the responsible officials and the public on the need of some method of Government supervision of Beach Protection.

The Beach Erosion and Coast Protection problems of Southern California have a direct bearing on the development and welfare of our ports.

An interesting paper on the first Government work for the improvement of the Los Angeles-Long Beach Harbour area by Lieut. Clinton B. Sears, Corps of Engineers, U.S.A., is printed in the Transactions of the American Society of Civil Engineers, Vol. V., 1876. Lieut. Sears discusses principles of tidal harbour improvements as applied to this locality and mentions some of the trials and tribulations of an engineer in dealing with the forces of the Pacific Ocean. This first improvement was the construction of a jetty between Rattlesnake Island (now known as Terminal Island), on which Reeves Field is located, and Dead Man's Island, designed to deepen the San Pedro Channel by the scouring power of tidal currents. He studied the beach from San Pedro to Long Beach and concluded that the shore conditions were in equilibrium when the U.S. Government began operations in 1871.

Prior to our Port development, San Gabriel and Los Angeles Rivers flowed into the Long Beach and Wilmington estuaries bringing in great quantities of silt and sand. It has been necessary to divert these rivers from the harbours in order to prevent shoaling of the slips, channels and turning basins.

This is also true of the Newport Bay Harbour Development. The Santa Ana River formerly flowed into the bay and it was necessary to establish a new ocean outlet and dam the old channel into Newport Bay before extensive harbour development could be undertaken.

These necessary harbour improvements and other man-made structures which have been constructed along the Southern California Coast have caused serious erosion problems on the leeward side; notably among which are the Santa Barbara Breakwater, the Santa Monica Breakwater, Ballona Creek Flood Control Jetties, Redondo Beach Breakwater and the Long Beach Rainbow Pier.

This erosion is progressive and has proceeded to the point where seasonal erosion menaces and is destroying improvements formerly considered safe.

## *Beach Erosion and Coast Protection—continued*

The direction of the Southern California Coast is north-westerly and south-easterly. Prevailing winds throughout the greater portion of the year are from the North-west. Accordingly, wind and wave conditions produce a predominating south-easterly littoral sand movement. At certain seasons there is a lesser north-westerly sand movement due to southerly and south-westerly storms. The sandy beaches experience a seasonal erosion each winter, and later in the year much of the sand previously eroded is returned. Where serious damage has occurred, however, it is due primarily to the effect of structures such as breakwaters, jetties and groynes which have disturbed the natural balance or equilibrium of the sand drifting forces along the sea coast.

The principal and dependable source of sand supply for our short line is from the rivers and streams brought down during the rainy season, especially during storm run-off. Flood control measures now being put into operation will tend to reduce this source of supply by the construction of regulating reservoirs and debris basins.

There is need in Southern California for a planned programme of beach protection, acquisition and development. To date planned development along our coast is fragmentary. The splendid results that have been attained by the Long Island Park Commission under the leadership of Mr. Robert Moses show what can be accomplished.

A number of co-operative investigations of beach erosion have been made in Southern California by the United States Erosion Board and local authorities; a current study with the City of Long Beach is about completed and a report is expected within the near future.

Mr. Smith calls attention to the Board of Commerce and Navigation of New Jersey, charged with the duty of promoting the welfare of the Jersey waterfront, whether such waterfront be dedicated to commercial and shipping purposes or used for yachting and beach recreation development.

If the citizens of Long Beach should follow the fine example of New Jersey and transfer jurisdiction over all the city tidelands to the Harbour Commission, the engineering, financial and legal problems of beach erosion and protection could be co-ordinated and dealt with efficiently under a comprehensive plan for commercial shipping, yachting and recreational beach development.

The beaches of Southern California are among its greatest assets. People from all over the nation have been invited to come here and enjoy them. But they are already over-crowded. Unfortunately little has been done by the public to acquire and develop the coast line and much of the best beach property has been privately exploited. It is obvious that further provisions must be made for the recreational requirements of our ever-increasing population which is creating a tremendous demand for beach recreation.

## *Obituary*

### *Death of Sir D. Owen*

The death on May 17th at Chicago, U.S.A., of **Sir David John Owen,** former General Manager of the Port of London Authority and prior thereto, General Manager and Secretary of the Belfast Harbour Commissioners, came as a shock to his many friends and old colleagues in port circles, although it was known for some time past that he was gravely ill. He was 67 years old.

A biographical sketch of his career, with portrait, appeared in the issue of this Journal for September last. In the same issue the announcement was made of the invitation extended to him by the Government of Hong-Kong to visit that port and advise as to its future administration. Sir David had completed his investigation and was on his way home when he was taken ill.

Although living in retirement after leaving the service of the Port of London Authority, Sir David continued his activities in a number of directions, notably as a Kent County Councillor and as a member of the Beckenham (Kent) Borough Council, where his wise counsel and business aptitude were widely appreciated. His long record of valuable public service will be gratefully remembered.

The death is announced of **Mr. Enos Lee,** traffic manager at Bristol City Docks. Mr. Lee spent the whole of his commercial career in the service of the Bristol Docks and served in all the principal administrative departments of the docks undertaking, both at Avonmouth and Queen Square, Bristol. He was honorary secretary of the local branch of the Institute of Transport and also secretary to the Port of Bristol Emergency Committee.

Early in May **Mr. Robert H. Smyth,** chairman of the Londonderry Harbour Commissioners, for the past fourteen years, died suddenly. He had extensive business interests in the city, of which he was His Majesty's Vice-Lieutenant, and he had devoted much of his time to the development of the port.

The death is also announced of **Mr. Robert Watson,** of Portrush, Co. Antrim, who acted as chairman on six occasions during a 27-years membership of Londonderry Harbour Board.

## *Notable Port Personalities*

### *XI.—Mr. M. J. Watkins, M.Inst.T.*

**Mr. Michael J. Watkins,** M.Inst.T., General Manager and Secretary, Belfast Harbour Commissioners, son of late Captain John Watkins, of Liverpool, was born at Liverpool in 1875.

He was educated at Granby Street School, Liverpool Institute and at Liverpool University.

*Photo by* [*Chas. H. Halliday & Co., Belfast*

Mr. MICHAEL J. WATKINS, M.Inst.T.

He entered the service of the Mersey Docks and Harbour Board in 1893 as an apprentice in the office of the General Manager and Secretary (the late Mr. Miles Kirk Burton). In 1911 he was appointed Assistant Secretary to the Humber Conservancy Board, Hull. In 1922 he succeeded Mr. (afterwards Sir) David J. Owen as General Manager and Secretary to the Belfast Harbour Commissioners. He has been closely identified with the extension, re-organisation and modernisation of the Port of Belfast and the creation of Belfast Harbour Airport—one of the finest in the British Isles.

He has been a member of the Institute of Transport since 1924, and has represented Northern Ireland on the Executive Committee of the Dock and Harbour Authorities' Association since 1922. He is Chief Executive of the Belfast Port Emergency Committee.

## *Proposed Alterations at Calcutta Dry Dock*

A report, recently issued by the Commissioners of the Port of Calcutta, refers among other matters to certain major repairs adjudged to be necessary at No. 1 Dry Dock, Kidderpore Docks. The work was to have been commenced in January and it is hoped to complete it within six months. The cost of the repairs, estimated at Rs. 93,513, will be met from revenue, and provision for an expenditure of Rs. 60,000 was made in the port's budget estimates for the current financial year.

The present keel blocks in the dry dock are only 2-ft. 5-in. high, the Commissioners state, and complaints have been received that work on the bottoms of vessels is difficult. It has been suggested that the opportunity should be taken while the dry dock is out of commission to provide new keel blocks 4-ft. 6-in. high of the type used in the King George's dry docks, which have proved satisfactory and give a better distribution of the load on the floor of the dock. Estimates have been prepared for new keel blocks amounting to Rs. 62,134, after allowing a credit of Rs. 8820 for the scrap value of the old blocks, and it is recommended that this estimate be sanctioned as a charge to capital. It is hoped to effect a saving against the estimate of Rs. 62,134 by handing over the old keel blocks and other material required for the construction of the new blocks to the contractors selected for their construction. It was recommended for sanction as a charge to capital the estimate of Rs. 62,134, for the provision of new keel blocks, and an order was approved to be placed with the Britannia Engineering Company for the manufacture of the blocks at a cost of Rs. 36,840, scrap iron to be supplied by the Commissioners.

# *Concrete in Sea Water**

## *Need for a Revised Viewpoint*

By HOMER M. HADLEY, Assoc.M.Am.Soc.C.E.[1]

**Synopsis**

RESULTS of extended observations of concrete marine structures, along the Pacific Coast of the United States and Canada, are presented in this paper. No evidence is found of sea water (sulphate of magnesium) attack on the concrete; where deterioration has occurred, it has been due to other causes. It is concluded from the uniform absence of sulphate attack in the wide range of concretes and cements involved in these structures that special precautions against sulphate attack are needless. It is concluded, however, that in sea-water concrete every care should be exercised to use sound materials, to obtain uniform density and impermeability of concrete, and to protect reinforcement from corrosion.

### Introduction

The final criterion by which the behaviour of anything in nature is to be judged is not the behaviour of some similar thing; it is not the advance opinion of authority; and it is not the preliminary findings of laboratory investigation and research. The final criterion of behaviour is no more or less than the actual behaviour itself, and it is by their conformity and agreement with this actual behaviour that the preliminary bases of judgment are to be appraised and assessed. If there is agreement, well and good. If there is disagreement, then it is the preliminary finding that must be adjusted and revised; it is not the actual deed that must be denied.

This Paper attempts to summarise the actual behaviour of concrete marine structures along the Pacific Coast. How can that behaviour be truly presented? When the mountain did not come to Mohammed, Mohammed went to the mountain. Nothing similar is possible here in the case of the average reader. The best that can be done is to submit representative views of structures taken in the very act of " behaving," in place, and to invite consideration of these views in combination with other stated facts, all of which evidence, of course, is subject to quite independent check and examination by those to whom access to the structure in question may be available.

The writer is quite aware that there is a large body of opinion at variance with the views set forth in this paper. He regards it desirable, therefore, to focus attention on the question at issue—the behaviour of concrete marine structures in service and the existence, in any form, of deterioration in such structures, apart from the enumerated kinds, which is definitely and peculiarly attributable to the sulphate action of sea water upon the hydrated cement of the concrete. Otherwise stated, the question is: Does any form of deterioration occur in the concrete in sea water that would not develop if the exposure were changed to similarly agitated, similar fluctuating, fresh water? In the considerable body of evidence that exists along the Pacific Coast, the writer is aware, with noted exceptions, of none whatever. It is also to be observed that it is with sea water in its normal range of concentrations—not with other sulphate waters—that the Paper is concerned.

### The Prevailing Viewpoint

> " Many engineers who are most experienced in marine construction are of the opinion that all concrete structures in salt water, and a considerable proportion of those near salt water in warm climates, deteriorate steadily and surely."[2]

The words express a widely accepted opinion that deterioration is inevitable. It is supposed to result from the combination of sulphates of magnesium in the sea water with free lime in the hydrated cement from the consequent formation of calcium sulphate which either by dissolution or expansion disrupts the concrete and affects its destruction. Periodically, in the technical press, reference is made to the sulphates of magnesium in sea-water attack on concrete in the most casual, matter-of-fact manner, as if it were definitely proved—an established reality. Remedies are proposed for it.

Under these conditions it is, to say the least, extraordinary that nowhere along the Pacific Coast, from Canada to Mexico, has the writer been able to find any evidence in concrete marine structures that an attack of such a nature occurs. Deterioration of various kinds assuredly is to be found. There is much of it in certain localities. Sometimes it is very serious; sometimes it is minor and trivial. None of it, however, is of a character to satisfy the sulphate of magnesium-free lime explanation which Messrs. Atwood and Johnson state[3] was advanced by L. J. Vicat. They quote E. Candlot as follows:—

> " According to Vicat, it is the action of this salt (sulphate of magnesia) to which must be attributed the rapid decomposition of lime and of certain cements by sea water; the sulphate of magnesia combines with the free lime of the mortar and is transformed into sulphate of lime; the magnesium is precipitated. If the current of the water which traverses the mortar be somewhat rapid, the sulphate of lime is carried out, a new quantity of lime enters into solution, is in turn transformed into sulphate, and the *gangue* thus decomposes continuously and finishes by forming only a sandy mass. When the current is weaker or is produced only at rather long intervals, the lime sulphate may crystallise and thus cause the expansion of the mortar. It is to this cause that we may attribute the phenomenon of expansion of mortars decomposed by sea water."

From the foregoing it appears that there should be either a progressive leaching out of the calcium sulphate with a correspondingly developed porosity and weakening of the concrete, or the concrete should become swollen, disrupted, and disintegrated by crystallization of the calcium sulphate. Furthermore, although there is no definite statement of the time rate at which these changes occur, it is to be assumed that they take place at a rate sufficiently rapid to show some indication of this deterioration after a reasonable period of time—say twelve or fifteen years. Certainly one should not be compelled to wait longer than that to find the first traces of it if it is a matter of any practical consequence.

With the understanding, then, that the characteristic form and manifestation of sulphate of magnesium attack on concrete is either a developed porosity or a swollen disruption of the mass and, after extensive inspections and examinations of many structures which uniformly fail to reveal deterioration of the requisite type, it is repeated that there is no evidence in concrete exposed to sea water along the Pacific Coast to substantiate the sulphate of magnesium-free lime theory. The confirmation is not to be found, however diligent the search. On the other hand, when a large amount of concrete (made with many different brands of Portland cement) is seen that has been subjected to full sea-water action for fifteen, twenty or more years and still has the original wood grain and form marks showing in its surfaces; still has clean, sharp corners and offers flinty, hard resistance to hammer blows; and is utterly lacking in deterioration, there is no avoiding the conclusion that the sulphate of magnesium-free lime deterioration theory is deficient in that indispensable necessity of all valid theories—proof. If, as is said, sea water attacks concrete, why does not all concrete deteriorate? Why, even in deteriorated structures, is most of the concrete free from deterioration in spite of having the same identical exposures as the deteriorated parts?

### Concrete a Generic Term

It would be well at the outset to consider what concrete is and to recognise that the term is a broad and generic one. Concrete is the name given to any hardened mixture of Portland cement, water, and fine and coarse aggregate. If the coarse aggregate is lacking, the mixture is called mortar, but otherwise the name concrete is given, regardless of wide variations in the proportions of the several components of the mixture and regardless of the manner and method by which it is mixed and placed in its forms. Whatever it is, it is called concrete as long as its material components are as stated. The consequence of this convention is that the behaviour of concrete under any particular set of conditions may vary widely, depending upon the particular concrete that is subjected to the exposure. Quite similar would be the variable behaviour of rock which, if it were hard granite, would behave in a markedly different manner than rock which was a soft sandstone.

It is to be expected that a wide range of mixes has been used in concrete marine work, and such indeed is the case. Likewise variable have been the methods of placement. It is apparent in many structures that care has been exercised to place the concrete uniformly and without segregation. It is apparent in other structures that little or no concern was felt for the attainment of these objectives: The concrete was dumped into the forms in a carefree, happy-go-lucky fashion, contentment abiding in the knowledge that " sufficient unto the day is the evil thereof." In reinforced structures the thickness of the protective covering over the bars varies in different jobs as does the quality of concrete in the covering. Out of all these variables, manifestly, there are opportunities for diverse behaviour of " concrete in sea water," and it is not surprising that deterioration of various kinds has developed.

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*Reproduced from the Proceedings of the American Society of Civil Engineers.

[1]Regional Structural Engr., Portland Cement Assoc., Seattle, Wash.

[2]" The Disintegration of Cement in Sea Water," by William G. Atwood, M.Am.Soc.C.E. and Arthur A. Johnson, "Transactions," Am.Soc.C.E., Vol. LXXXVII (1924), p. 205.

[3]" Loc. cit.", p. 207.

## *Concrete in Sea Water—continued*

### The Sea-Water Exposure

The sea-water exposure itself varies widely. In the most sheltered and protected locations there is the rise and fall of tides with alternate wetting and drying of the concrete. Waves, swells, and the wash of ships frequently amplify the tidal wetting. Flotsam and drift are tossed about by the water and deliver mechanical blows. On the open ocean coast, storm waves themselves deliver tremendous thrusts and blows against the structure and may roll and grind loose boulders against it; moreover, along the Pacific Coast, from San Francisco (California) north, the forest mantle of the country yields great quantities of drift which

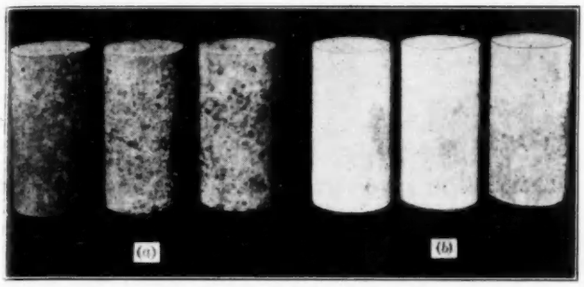


Fig. 1. Wire-Brushed, 2-in. by 4-in. Cylinders after Five Years Immersion in Fresh Water.

sometimes may be whole logs and trees that form heavy battering material. Additional to this along some coasts are the disruptive effects of ice and freezing. All in all it must be recognised that, quite as a marine exposure is a poor place for rock of a soft shale, indurated mud type, so, likewise, is it unsuited for lean, porous concrete of segregated, random structure.

### Deterioration by Mechanical Attack

Indeed the most striking and characteristic forms of deterioration to be found in concrete exposed to sea water are those due to deficiencies in the quality and structure of the concrete itself: Weak concrete is abraded, honeycombed areas become full cavities, laitance seams become extended voids, construction joints and pour planes tend to chip and widen at their edges, and sharp corners and projections become broken and knocked off. The processes of attrition and erosion by which, in the long reaches of time, all things are reduced to fragments and to dust are in aggressive action on the ocean's shores, and that which is vulnerable to attack is speedily revealed. On the other hand, strong, sound concrete that is uniformly dense and impermeable shows but slight change in a quarter century or more and quite merits the term " permanent " in the time scale of human affairs.

Such contrasting aspects of concrete in sea water obviously result from variations in the concrete itself. They have nothing to do with sulphates of magnesium in the sea water, nor with the sulphate-resistant qualities of cement. Deterioration such as that described is due to physical and mechanical causes and could, and would, occur as well if the ocean were of fresh water instead of

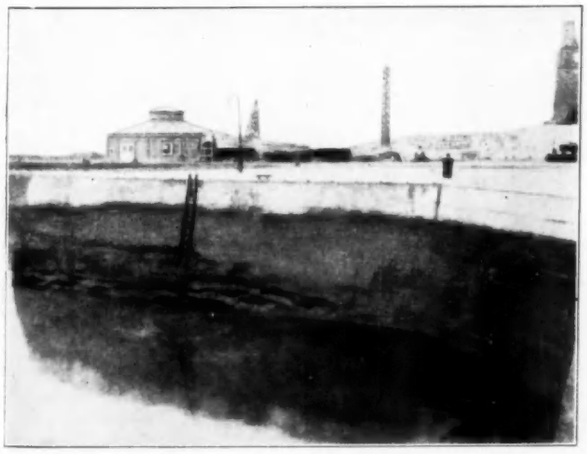

Fig. 2. Quay Wall D, Puget Sound Navy Yard, Bremerton, Wash.

salt water. Unfortunately, a great deal of writing has indiscriminately lumped all forms of deterioration together as " sea-water attack," whence the conclusion is readily drawn that it is the sea water itself that exercises a peculiarly malign effect upon the concrete. For resistance to this, the commonest form of deterioration in concrete exposed to sea water, it is safe to say that making concrete which is fresh-water resistant or frost resistant elsewhere will furnish full and adequate protection.

### Rusting of Reinforcement

In reinforced structures, the second most common form of deterioration is that due to rusting of reinforcement, disruption of the covering concrete, further corrosion of steel with loss of section, loss of bond, etc. It develops most frequently in members of small section—piles and the stems of beams and girders. Unprotected steel rusts. It rusts very slowly in a dry climate and more rapidly in a moist climate. It rusts most rapidly and heavily of all along the sea coasts where the air may carry minute drops of salt water in suspension, caught up from waves and surf. In such an atmosphere, rust will form quickly on reinforcing bars wherever the covering concrete is porous or absent. If possible it will develop progressively along the bar and with its inevitable expansion will split and disrupt concrete. The primary remedy is to provide dense, impermeable concrete and adequate cover. Around salt water is a poor place for scant cover over reinforcement, for misplaced reinforcement, or for lean concrete. However, it is to be noted that, although the rusting of reinforcement is indeed aggravated and accelerated by the salt-water exposure, it is wholly independent of the sulphate-resisting properties of the cement used in the concrete. Consequently, here again, primary importance attaches to density and impermeability and to the thickness of the protective concrete rather than to other things. Additional protective measures that may be accepted as thoroughly effective are the asphaltic impregnation of concrete piles, extensively used by the Los Angeles (California) Harbour Board[4], and the ingenious system of applying an asphaltic coating to the underside of a concrete deck, developed and used by the engineers of the San Francisco Harbour Board.[5] To the best of the writer's knowledge, these methods have been 100% effective in accomplishing their respective objectives.

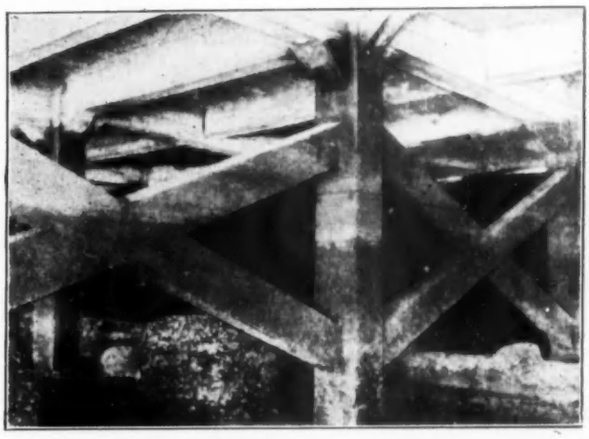

Fig. 3. Typical View of Substructure of Ferry Pier, North Vancouver, British Columbia, built in 1909.

### Solvent Action

Occasionally there is evidence of a slight solvent action of sea water on concrete. The original surface film of cement has disappeared, or a honeycombed spot weakens and loosens some pieces of aggregate. In time, porous concrete may appear to become increasingly porous. Such changes are not peculiar to sea-water exposure, however. They can occur equally in fresh water. Long-time tests made in the testing laboratory of the City of Seattle, Washington, about 1925, by T. H. Carver, M.Am.Soc.C.E., clearly showed a minute but definite dissolution of concrete in flowing fresh water, which dissolution did not occur in still water. In Fig. 1 (a), the cylinders on the left were stored in a tank through which a slow steady flow of Cedar River water was maintained. Those on the right (Fig. 1 (b)) were stored in still water in sealed jars. The mixes were, left to right, 1-1-2, 1-2-4, and 1-3-6, respectively, in both Fig. 1 (a) and Fig. 1 (b). After five years the standard-cured 2-in. by 4-in. cylinders, in Fig. 1 (a), all showed evidence of attack. The specimens of 1-3-6 mix had entirely lost their surface films of cement paste; the 1-1-2 specimens could have theirs removed easily by wire brushing. The companion specimens, in Fig. 1 (b), stored in still water in sealed jars, were unaffected. The loss of strength, running-water storage compared with still-water storage, was markedly greater with the lean mixes than was the case with the richer mixes. The desirability of an impermeable concrete was clearly shown. In the case of sea water, there is a continual change of water with tides, currents, surf, etc. There is ample evidence from both laboratory and field investigations of the need for density and impermeability in concrete exposed to sea water, and also in concrete exposed to fresh water.

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[4] "Civil Engineering," November, 1931, p. 1245.

[5] "Engineering News-Record," June 8th, 1939, p. 771.

## *Concrete in Sea Water—continued*

### Freezing

Disruption of porous concrete by the freezing of absorbed water does not occur along the Pacific Coast of the United States, not because there is no porous concrete to be found, but because freezing seldom, if ever, occurs. Such disruption of porous concrete by freezing is quite independent of sea water, however. It occurs with both fresh and salt water.

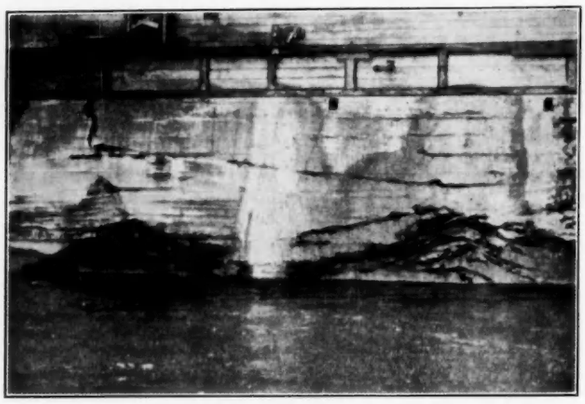


Fig. 4. Detail of Old Waterfront Wall, Seattle, Wash., Built in 1913.

### Evaporation

Disruption may likewise develop with porous concrete in the tidal zone or above if evaporation produces seriously harmful concentrations of sea water in the pores. The late C. S. Pope,[6] M.Am.Soc.C.E., has presented a view of the top of a sea wall that shows scaling and deterioration which were undoubtedly due to concentrated saline solutions and crystallisation produced by evaporation. This is a form of deterioration which is indeed peculiar to sea water and not to fresh water. In general, however, it is of limited occurrence, since the usual freedom of drainage appears to prevent it. The flat top of the sea wall cited by Mr. Pope acted to trap and hold a certain amount of spray thrown upon it, and with rather porous concrete and aggregate the consequences were as shown in Fig. 1.

### Unsound Materials

Still another type of deterioration—that due to the use of unsound materials in the manufacture of concrete—is to be found. This is characterised by a pronounced general expansion of the entire body of the concrete and much cracking. There are two distinct varieties of this classification. The common one is that in which the concrete remains hard and is entirely unaffected by the sea water. In the other variety the concrete softens into a mushy mass practically devoid of cohesion.

Concrete is composed of cement, water, fine aggregate, and coarse aggregate. The coarse aggregate is a highly unlikely cause of a general and all-pervasive expansion in a concrete structure free from local poppings and pittings and may be dismissed from consideration in all but exceptional cases. So, likewise, are differences in mixing waters, although, as the agent initiating the hydration of cement, mixing water may be regarded as a cause. Perhaps strongly alkaline waters under some conditions may be unfit for use, although sea water itself, notably in the case of the Florida East Coast Railway Extension to Key West, has been used as mixing water in a number of instances with no appreciable ill effects. There remain the cement and fine aggregate. The latter is almost always a natural sand produced by weathering and erosion of a great variety of rocks, and is transported, intermingled, and deposited by streams. Depending upon their origin, sands from the same pit may be of definitely uniform or of utterly diverse and random mineralogical characteristics. It is a common and usually valid assumption that natural sands are stable, sound, and chemically inert, but this assumption, easy though it is to make, is not necessarily true. It is cement and sand, individually or in combination, that must be considered as possible causes of the expansion referred to.

Improperly manufactured cement may indeed be the cause of the trouble. Nevertheless, the adoption of modern improvements in manufacturing and test procedure should give the engineer increased confidence in the capability of portland cement to meet fully all reasonable construction requirements. More careful grinding and particularly blending of the raw materials insure more uniform and correct burning and therefore a more dependable product. New and more severe tests for soundness detect any tendency toward delayed unsoundness. However, the cases of deterioration in existing marine structures in which serious expansion has occurred are not numerous, and those in which this expansion is properly to be charged to the cement alone—that is, wherein the aggregate is not partly or completely responsible—have yet to come to the writer's attention.

Expansion of the type in which the structure cracks but the concrete remains hard and not observably affected by sea water is discussed and illustrated in a series of valuable papers by Thomas E. Stanton,[7] M.Am.Soc.C.E. The original paper, presented at the annual meeting of the Society in January, 1940, describes a typical case of such expansion in a sea wall in Ventura County, California. In March, 1940, the writer discussed[8] the condition of this sea wall and others near by. There appears to be no reasonable doubt that the nature and cause of deterioration of this kind have been definitely established by the notable work of Mr. Stanton and his associates. This form of expansion has developed in bridge piers and abutments in fresh-water streams—for example, the highway bridge across the Salinas River at King City, California.

A. A. M. Russell, Assoc.M.Soc.C.E., has made some tests which brought into definite and almost dramatic focus hitherto confused and obscure causes of trouble of the expansion-softening type. From a pit from which had come the sand used in a waterfront structure that developed very serious deterioration of this type in a few years time, he obtained sand samples, and for comparison he used sand from another pit, several hundred miles distant from the first pit, and of unknown soundness. Petrographic examination of the questioned sand revealed a heavy percentage (more than 40%) of feldspar grains which proved to be of a highly unstable nature.

As an accelerated test, equal samples of both sands were put in beakers of sea water, which were then placed on an electric plate and held continuously at a temperature slightly below boiling. In four days about half of the questioned sand had broken down and changed completely to a mud, whereas the other sand sample showed only a thin film of mud across its top surface. Then, as a direct sea-water test, briquet specimens were made up of the questioned sand and of standard Ottawa sand. The latter, consisting entirely of particles passing No. 20 and retained on No. 30 sieves, suggested a similar grading for the other sand. Consequently, it was sieved into three gradings and three different mixes were prepared. In one mixture only particles passing the No. 10 and retained on No. 20 sieves were used; the second had only particles passing No. 20 and retained on No. 30 sieves—that is, the Ottawa sand grading; the third mixture had a grading with particles ranging uniformly from fine to coarse. After tension tests were made, the briquet fragments were placed in jars of sea water and were kept at room temperature, the sea water being renewed occasionally as evaporation took place. In less than a year the Ottawa sand specimens were wholly unaffected, having hard sharp edges and no trace of deterioration. The same was true of the specimens of the questioned sand that had the fine-to-coarse grading and were therefore of reasonably dense structure.

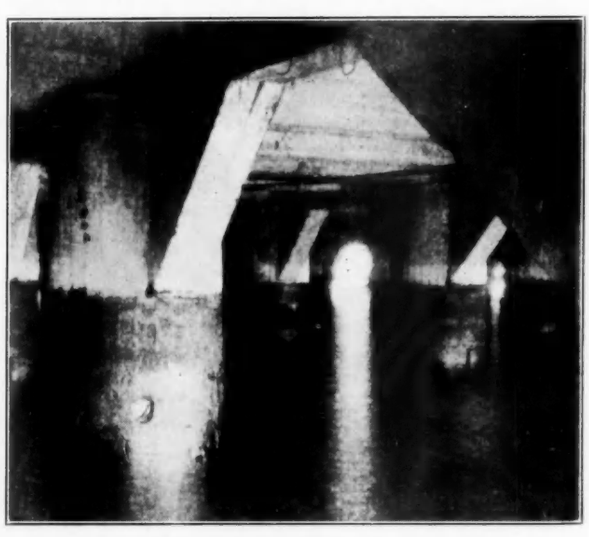


Fig. 5. Broadway Pier, San Diego, California, Built in 1912.

The specimens made with the No. 10 to No. 20 mesh particles were beginning to soften slightly on their edges but were in fair shape. The No. 20 to No. 30 mesh samples, on the other hand, were in an advanced state of disintegration. They had swelled, cracked, were slimy on their surfaces, and their edges were soft and crumbly. These specimens, being directly comparable in every respect to the specimens made with Ottawa sand and with the same cement from the same rack (which Ottawa sand specimens were wholly unaffected), showed conclusively, in conjunc-

[6] "Transactions," Am.Soc.C.E., Vol. 98 (1933), p. 511.
[7] "Influence of Cement and Aggregate on Concrete Expansion," by Thomas E. Stanton, "Engineering News-Record," February 1st, 1940, Fig. 2, pp. 59-61.
[8] "Engineering News-Record," March 14th, 1940, p. 45.

## *Concrete in Sea Water—continued*

tion with the preceding accelerated test on the sand, that the unsoundness in this case was in the sand and not in the cement.

Inasmuch as the deterioration produced closely resembled that in the structure built with this sand, it appears to be established, at least in this case, that the sea-water attack was on the sand and not on the cement. It is scarcely conceivable that this trouble could have been avoided by special sulphate resistance or other special qualities in the cement. It is a fact that serious deterioration of this type appears to have developed in a section of the coast of rather marked geographical limits. It should be added that it is only in sea water that the writer knows of the occurrence of this form of deterioration, and indeed it may be that this feldspathic sand is particularly unstable in sea water. Its use for any concrete anywhere, however, appears to be questionable.

Fig. 6. Pier on San Francisco Waterfront, Built in 1909.

There are a few cases known to the writer where concrete in exposed locations appears to have developed expansion troubles somewhat intermediate between the two types—that is, there has been cracking of the type described in Mr. Stanton's papers with apparently a certain softening of the concrete. This has resulted in the complete destruction of parts of the structures. Extensive cracking of exterior surfaces due to expansion of the interior of the mass, of course, greatly weakens resistance to flexural stresses; similarly, such complete prevention of longitudinal expansion in certain sections as to lead to crushing at the ends would practically destroy their resistance to the pounding of waves at such points. Whatever the exact cause of the trouble in these cases, there is no uncertainty about abnormal expansion; it is to be avoided and eliminated. It is believed that the preceding covers all the main types of deterioration that are to be found in Pacific Coast concrete marine structures

### Subjective Deterioration

Another trouble of concrete in sea water has nothing to do with the sea water. This trouble arises from hasty observation and incomplete reporting of conditions. In glowing zeal to establish either broad generalisations or the urgent need for the adoption of certain safeguards, only as much of the evidence is adduced as supports the contention. This frequently creates in readers' minds an entirely erroneous idea of conditions.

Fig. 2 shows a view of an old quay wall at the Puget Sound Navy Yard, Bremerton, Washington, built in 1901 and known as quay wall D. It extends from the stepped-off joint at the re-entrant angle to the corner at the extreme left. At the right of this section and in the right foreground of the view is a portion of quay wall E, constructed in 1896. The deep cavities and extremely bad conditions at the base of wall D are clearly apparent. Likewise clearly apparent is the condition of the wall above the base portion which is extremely hard and to-day (1940) shows no trace of deterioration, the wood grain and form marks being discernible through the coating of fuel oil which now covers it. An official statement regarding this condition is the following:—

> " The bottom part of the west wing wall from the stepped-off joint to the south corner was poured in 1901 with a tremie up to a point where the water could be expelled from the open cofferdam, probably three feet higher than the water level in the photograph."

Regarding this same wall, the following is the complete report,[9] published in 1924 by the National Research Council:

> " Quay Wall D—This is a gravity type wall built in 1901-02. Local aggregates and condon [Condor] cement were used in the proportions of 1 : 2½ : 5. This concrete was hand mixed and deposited below water level by tremie and above with wheel barrows.
>
> " The inspection of March 8th, 1923, showed this wall to be badly deteriorated, though ' Gunite ' repairs had been made."

Although this report is literally true, it nevertheless creates a wholly erroneous impression since no reader would know that the upper part of the wall, also in sea water, made with the same cement as the base, was practically free from deterioration on March 8th, 1923. With the same construction methods, any and every cement regardless of type or composition that might have been used in this wall would have been similarly attacked or not attacked by the sulphates of magnesium in the sea water, depending on whether it was dumped through a tremie tube or deposited by wheel barrows. Many reports of sulphate of magnesium attack on concrete in sea water are of the foregoing character.

### Summary.

The harm resulting from misunderstanding a natural phenomenon arises from the likelihood that measures adopted to effect changes and alterations in it will be misdirected. There is no particular reason for research and for grave alarm over the strong links of a chain so long as there are weak links that need strengthening. Not until the real hazards of sea-water use are definitely foreseen and are guarded against is there need for such extreme refinements as protecting against sulphates of magnesium —and no particular harm will result if this safeguarding is completely neglected.

This paper is based upon visual observations of concrete structures in sea water along the Pacific Coast and is concerned with sea water only. It is intended that its statements and conclusions apply to sea water only—not to those sulphate waters and exposures elsewhere which assuredly require special measures and treatments. The dearth of supporting laboratory data may be regarded as somewhat unusual, but it is hoped that the references to the work of Messrs. Carver, Stanton, and Russell will supply this deficiency in some measure. After all, it really is not necessary to have laboratory confirmation of that which is spread obviously before one's eyes.

Probably no better ending could be made to this paper than to append a short list of some representative older concrete-in-sea-water structures, variously located, which exemplify the behaviour of sound, impermeable concrete and which may be examined by anyone. Several views are shown in Figs. 3 to 7. These structures are not without flaw or blemish. Some of them have bad spots such as patches of honeycomb dating from original construction, or have been worn by abrasion. However, they have had twenty or more years of sea-water exposure, and their concrete is substantially free from trace of sea-water attack. They were built at different times, with different brands of cement, which assuredly varied in their percentages of tricalcium aluminate and other compounds, and with different construction methods. After the examination let the observer ask himself the question: Where is the sulphate of magnesium attack? Assuming that there is only one conclusion—namely, that he has not seen any—it is then fair to ask why it is not to be found. It is to be hoped that he will look for it elsewhere—not in books, but along the waterfront. This paper is intended to present the idea, definitely, that such an attack on concrete in sea water does not occur and therefore need not be guarded against. On the other hand, it would re-emphasise what many observers have stated before—the need of adequately protecting reinforcement from corrosion and of having dense, impermeable concrete made of sound and enduring materials.

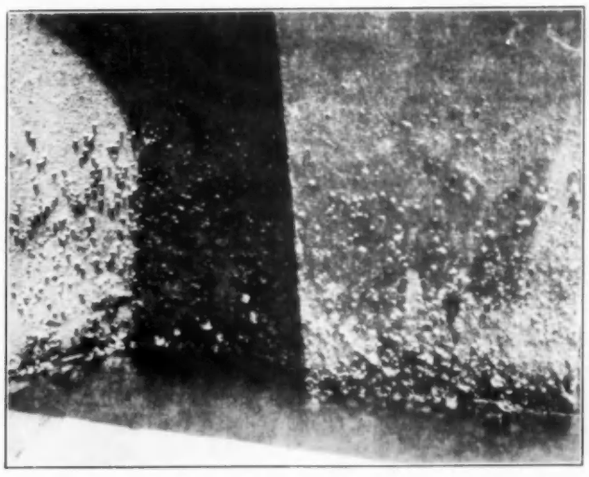


Fig. 7. Detail of Abutment of East Neapolitan Bridge in Naples District, Long Beach, California, off Alamitos Bay, Erected in 1913.

Representative older structures evidencing no sulphate of magnesium attack upon their concrete are the following:—

| | | |
|---|---|---|
| North Vancouver, B.C., Canada, Ferry Pier | | 1909 |
| Victoria, B.C., Canada, Dallas Road Sea Wall | | 1911 |
| Seattle, Wash., Sea Wall south of Madison Street | | 1916 |
| Bremerton, Wash. (Puget Sound Navy Yard) | Quay Wall E | 1896 |
| | Quay Wall D | 1902 |
| San Francisco, Calif. | Cylinder Substructure, Pier 38 | 1909 |
| | Precast Pile Substructure, Pier 17 | 1912 |
| Los Angeles, Calif. | Lighthouse Base, San Pedro Breakwater | 1910 |
| | Piers of Southern Pacific Railway Bascule Bridge at West Basin | 1912 |
| San Diego, Calif., Broadway Pier (see Fig. 5) | | 1912 |

[9] "Marine Piling Investigations," National Research Council, 1924, p. 403.

## *Concrete in Sea Water—continued*

Reports of 27-year tests of concrete specimens, made with five different brands of cement immersed in sea water on the San Pedro breakwater at Los Angeles,[10] were published in 1932. These specimens were made in 1905 by the U.S. Engineer Department and were exposed in the tidal zone. No evidence of sulphate of magnesium attack was found in them nor any deterioration other than abrasion due to mechanical causes.

Fig. 4 is a view of an old sea wall in Seattle, Washington, built in 1913. Part of the wall shows what is commonly called " sea-water attack," whereas most of the wall shows no attack. The cause of the trouble is self-evident.

In Fig. 6 (a), honeycombed concrete and sound concrete are shown side by side in the same cylinder, and both conditions occur at the water level. Fig. 6 (b) shows another cylinder that is honeycombed at the high-tide line and also above that line.

### Conclusions

Because of complete lack of evidence in concrete marine structures of sulphate of magnesium attack upon them, there appears to be no valid basis for believing that such attack occurs.

The vitally important matter for concrete used in marine work is to have dense, impermeable concrete made of sound materials with adequate cover over reinforcement.

# *Bombay Port Trust*

## *Official Statement by Chairman on Financial Position and Estimates*

### Revised Estimates, 1940-41.

Budget Estimate of Receipts for 1940-41 on General Account was placed at Rs. 230.75 lakhs. It was framed on a conservative basis as it was then difficult to forecast the effect of the war on the trade of the Port. Although there has been a shrinkage of revenue from wharfage, both import and export, there has been a substantial improvement under other heads of the Wet Docks, notably Ground and Shed rents, Storage of goods in warehouses, Dock dues on vessels, Handling charges, and Miscellaneous (Trooping accommodation). This improvement is attributable mainly to war conditions which have also influenced the revenue of the Railway and the Dry Docks, the income from both of which is substantially in excess of the original anticipations. There has also been increased demand for occupation of the Trustees' estates and land revenue has gone up in consequence. Taking all these factors into consideration and allowing for revenue during the next 2½ months at about the level of the corresponding period of last year, I place the Revised Estimate for the current year at Rs. 255.18 lakhs, an increase of Rs. 24.43 lakhs as compared with the original estimate.

Raw cotton, ground nuts, myrabollams, kerosene oil, oil cakes, piece-goods, linseed, sugar and wool are among the commodities the export of which suffered a setback during the nine months ended December, 1940, as compared with the corresponding period of the previous year. On the other hand the export of coal (including bunkers), iron scrap and dross, manganese ore, fuel oil and castor seeds shows substantial improvement. A comparison of the import trade of the Port for the same period shows that the principal increases occurred in copra. Government stores, fuel oil and other heavy oils, twist and yarn and wines, spirit and beer, while there was a decline in the import of cement, lime and limestone, coal, raw cotton, glass ware, grains (rice and other kinds), machinery, motor cars and lorries, kerosene oil, petrol, paper and stationery, sugar and tea.

The Revised Estimate of Expenditure on General Account for the current year amounts to Rs. 230.52 lakhs as compared with the original estimate of Rs. 229.36 lakhs, an increase of Rs. 1.16 lakhs. The increase occurs mainly under Wet Docks, Hamallage establishment, and is due to extra labour supplied for Government work in connection with military traffic. As pointed out above, there has been a substantial increase of revenue from handling charges which more than offsets the increase in expenditure under this head. The remaining heads of account read with the relative details are self-explanatory and call for no comment.

### Budget Estimates, 1941-42

In regard to the Budget Estimates for the next year, the overriding factors are again the duration and progress of the war. These cannot be foreseen; but it appears safe to assume that present conditions will continue during the next year. On this assumption, the receipts for the next year are estimated at Rs. 245.23 lakhs which is about Rs. 10 lakhs less than the revised estimate of the current year.

Broadly speaking, I have assumed that while the revenue from the major head, Wharfage on goods, will remain at about the same level as that of the current year, the revenue from transhipment and overside and extra fees (included in Ground and Shed rents) will be less next year on account of less dislocation of shipping. A substantial reduction has also been made under Trooping accommodation (included under Wet Docks, Miscellaneous). A slight increase under Land revenue has been allowed for owing to the progressive nature of this revenue; while a reduced volume of traffic has been assumed on the railway for the reason that the current year's traffic has been abnormal. The other heads of account call for no special comment.

The estimate of expenditure for the next year, as a whole, closely approximates that of the current year. There are, however, variations, notably under Debt charges, which show a decrease of Rs. 1.22 lakhs due to the repayment of the 4% sterling loan of 1910. The increase of Rs. 0.69 lakh under Wet Docks is due to normal provision being made as usual in the budget estimates for staff and contingencies; while a like increase under Bunders and Land is on account of more dredging being anticipated in the bunders and the Pir Pau Channel.

As a result I estimate the surplus for the current year at Rs. 24.66 lakhs and for the next year at Rs. 14.46 lakhs.

In arriving at the above result I have assumed that the reductions and rebates in ground rents sanctioned since 1st October, 1933, as a measure of relief to our tenants will be continued for the present.

### Pilotage Account

With the continuance of the 20 per cent. rebate on Pilotage fees this account is practically in equilibrium, its surplus or deficit being adjusted against the Vessels' Replacement Fund. The balance of this fund is shown later in this Note.

### Capital Estimates

In the Budget Estimates for the current year provision was made for an expenditure of Rs. 11.33 lakhs which included a sum of Rs. 6.14 lakhs for the purchase of the Gun Carriage Basin. To finance the year's programme a loan of Rs. 10 lakhs was provided for, the actual amount of the loan being determined by the progress of works. The purchase of the Gun Carriage Basin has since been deferred and the revised capital programme of the year now amounts to Rs. 6.56 lakhs only. As the actual balance on hand on 1st April, 1940, was Rs. 7.37 lakhs, the current year's reduced programme can be financed from capital balances in hand and the raising of a loan during the current year is not necessary.

The capital programme for the next year aggregates Rs. 7.42 lakhs, the main items being as follows:—

| | Rs. Lakhs |
|---|---|
| Two dock tugs ... ... ... ... ... | 3.05 (part expenditure) |
| Lighting staircases and passages of workmen's quarters ... ... ... ... ... | .33 |
| Third pipe line for fuel oil ... ... ... | 1.01 (part expenditure) |
| Paving of floors, Grain Depot sheds ... | .64 (part expenditure) |

To finance the above programme a loan of Rs. 8 lakhs will be necessary and provision has been made accordingly.

### Reserves

The balance of the Revenue Reserve Fund on 1st April, 1940, was in excess of its sanctioned limit of Rs. 100 lakhs by Rs. 14.70 lakhs. With the anticipated surplus of Rs. 24.66 lakhs at the end of the current year the excess would amount to Rs. 39.36 lakhs. Proposals (since sanctioned) have been placed before the Board for the transfer of Rs. 41 lakhs from this fund to certain other funds which require building up. The estimated balances of the various Reserve Funds (excluding the General Sinking Fund and General Sinking Fund, Profit and Loss Account) will then be as follows:—

| | Sanctioned limit Rs. Lakhs | Balance as on 31-3-1941 Rs. Lakhs | Balance as on 31-3-1942 Rs. Lakhs |
|---|---|---|---|
| Revenue Reserve Fund ... | 100 | 97.00 | 111.17 |
| Emergency Fund ... ... ... | 20 | 14.66 | 12.76 |
| Railway Depreciation Fund ... | 68 | 29.83 | 27.10 |
| Fire, Marine and Motor Insurance Fund ... ... ... ... | 10 | 12.14 | 10.00 |
| Vessels' Replacement Fund, Pilotage Account ... ... ... | 10 | 10.15 | 9.38 |

### Debt

The position at a glance in regard to our debt is as follows:—

| | On 1-4-1940 Rs. Crores | On 1-4-1941 Rs. Crores | On 1-4-1942 Rs. Crores |
|---|---|---|---|
| (1) Balance of debt due to Government (repayable by annual equated instalments) ... ... ... | 4.49 | 4.28 | 4.06 |
| (2) Balance of debt due to the Public ... ... ... | 13.46 | 12.79 | 12.87 |
| (3) Accumulation in the General Sinking Fund for the amortization of (2) above | 5.04 | 4.65 | 4.93 |

H. K. KIRPALANI,
Chairman.

[10] "Western Construction News," June 25th, 1932, p 367.

# Legal Notes

## Use of Slings for Cargo Handling

A case of no little importance to stevedores and others concerned in the handling of ships' cargoes was heard recently in the Court of Appeal and for the information of our readers we reproduce below a report of the hearing of the action, extracted from *Lloyd's List* of May 2nd:—

It was the appeal of William John Gutteridge, a dock labourer, of Leslie Road, Custom House, London, E., from the judgment of Mr. Justice Tucker in the King's Bench Division on February 20th, 1941, dismissing his claim for damages for personal injuries against Frederick Leyland and Co., Ltd. He received the injuries on July 8th, 1938, while working for the respondent company's subsidiary, the Thames Stevedoring Company, at the Royal Albert Dock. He was helping to load iron pipes from a barge into the steamship "Rodney Star," when a pipe fell from a sling and struck his head, fracturing his skull. The respondent company denied negligence and pleaded that the negligence alleged was solely the negligence of the members of Gutteridge's gang and the shipworkers who were in common employment with Gutteridge.

Mr. Justice Tucker had held that the respondent company had laid down a proper system of working involving the use of a double sling, and that they could not be held responsible where the use of a single sling was occasionally acquiesced in by the supervisor appointed by the respondent company, although on the facts of this case his Lordship was not satisfied that the supervisor was aware that a single sling was being used. Therefore he dismissed the claim.

Mr. Blanco White, on behalf of the appellant, illustrated his argument by means of a miniature bundle of pipes and miniature single and double slings. When the gang started work, he said, a double sling was used, but, as the hatchway man said the pipes would not go down the hatch, a single sling was used and was still in use when the accident happened. Several times the men in the gang complained of pipes falling out of the bundle, but they were told to carry on. The result of the injuries Gutteridge received was that he would never be able to do any more heavy work. His case, said Mr. Blanco White, was that the use of a single sling without something to prevent pipes slipping out of the bundle, was a negligent system. But that was the system under which Gutteridge was required to work. The respondent company's answer, which the Judge accepted was: "We agree that the use of a single sling is a negligent method but our orders were to use a double sling. We knew that gangers were in the habit of using a single sling as soon as the superintendent's back was turned, but that is no responsibility of ours." To that the reply was that Gutteridge was under the ganger's orders, and if the gangers' practice, to the knowledge of their superiors, was to use a safe system when they were being watched and a dangerous system when they were not being watched, then the employers were not providing a safe system.

Mr. Blanco White then read to the Court the evidence and the judgment of Mr. Justice Tucker.

Having read the judgment, Mr. Blanco White said the real questions were this: Was a safe method of loading the pipes provided, and, was the method, if provided, affected by the adoption of the single sling method. He submitted that there had been no mere casual lapse in this case, but, according to the evidence, there was a regular system of using the single sling method. The respondent company, therefore, were liable. Counsel also maintained that the doctrine of common employment did not apply.

Mr. Baskerville, following, submitted that Mr. Justice Tucker applied to the fact a wrong legal principle, i.e., that what he had to decide was whether the use of the single sling had become so notorious to the respondent company or their agents that it had received their tacit approval, or whether it was a system adopted now and again by the men, as the easiest method of working. Upon that wrong principle the Judge drew conclusions that did not flow from the facts.

### Judgment

Giving judgment, Lord Justice MacKinnon said the question was whether the appellant had established that the accident was due to non-provision of a proper method or system of working by the respondent company and their servants, or agents, to whom they delegated the task of providing the system of working. His Lordship referred to Lord Wright's remarks in the case of Wilson and Clyde Coal Company v. English (1938), A.C. 57, when he said: "The obligations to provide and maintain proper plant and appliances is a continuing obligation. It is not, however, broken by a mere misuse or failure to use proper plant and appliances, due to the negligence of a fellow servant, or a mere temporary failure to keep in order or adjust plant and appliances, or a casual departure from the system of working, if these matters can be regarded as the casual negligence of the managers, foremen, or other employees."

In the present case, the judge found that the employers did provide a proper system, that the accident happened from a casual departure from that system, and that that departure must be regarded as the casual negligence of the foreman or other employees. On the facts, it was the casual negligence either of the appellant himself or of a man who was in no way his superior officer, viz., the hatchway man, or the foreman down in the hold. The foreman could not be said to have taken any responsibility, with regard to the negligent method of working adopted by the appellant or his fellow workmen.

His Lordship said he was in entire agreement with Mr. Justice Tucker, on the facts, and the only question before the Court was whether the appellant had established any error in law by the Judge. He could find no such error: on the other hand, he thought that Mr. Justice Tucker had rightly applied the principle laid down in Wilson and Clyde Coal Company v. English. In those circumstances the appeal must be dismissed, with costs.

Lord Justice Luxmore and Mr. Justice Oliver agreed.

## Joint Ministry of Shipping and Transport

### Statement by New Minister

In connection with his appointment as head of the Joint Ministry of Shippng and Transport (now War-time Transport), Mr. F. J. (now Lord) Leathers issued the following statement to the Press:—

"The organisation of our national economy for the maximum war effort demands that the entire transport system of this country should be considered as a unit. Our transport system begins at the ports abroad where our ships pick up the goods and raw materials which we require. From that point it extends to the factories in this country and to the doorsteps of the consuming public. In the other direction it starts with our factories here and carries their products to our Forces oversea and to our customers abroad. Hitherto this vast organisation has been the concern of two Government Departments, and this meant the drawing of an arbitrary line in what should really be one continuous process. This line was drawn at the ports, but the distinction was never very satisfactory, for if the ports were under the control of the Minister of Transport it was natural that they should be run with a view mainly to the conditions of internal transport. On the other hand, if the ports had been the concern of the Ministry of Shipping their organisation would have been directed more to the convenience of ships than of the railways or the roads.

"The fact that full information about ships' movements and cargoes was not under the same roof as full information about internal transport inevitably led to certain hitches and delays, though these have been steadily reduced to a minimum by the friendly co-operation of the two departments. No matter how friendly this co-operation might be, it was not possible completely to integrate the transport process under the control of two separate organisations. Indeed, for this reason the Government has decided that the Ministries of Shipping and Transport shall be merged into one Ministry; I am very proud and honoured that I have been called upon to take the responsibility for this new Department. At every stage the internal and external transport systems interlock and are interdependent. For example, even further back, the stowage of a liner loading in New York may have to be arranged in such a way that when the cargo is unloaded here it comes out in a convenient order.

"The arrangements for the amalgamation of the Ministries of Shipping and Transport are being worked out as fast as possible, but it is much too early yet to give any details. The process of amalgamation must necessarily take a little time to complete. I am very glad to say that a small Cabinet Committee, consisting of the Lord President of the Council, the Lord Privy Seal and myself, are working out these details and I hope that we shall be able to complete our task in the near future."

### Re-opening of Princes Pier, Greenock.

The Greenock Harbour Trust have re-opened a section of Princes Pier, which had been closed to traffic for over a year in consequence of its state of disrepair. Apart from this section which is opposite the eastern entrance to the railway station, the pier will remain closed for a further six months. The trustees have also decided to proceed with the reconstruction of another section of the pier adjoining the western entrance to the station.

It will be recalled, as published in these columns, that prior to the war, the pier had fallen into such a state of disrepair that the structure was pronounced to be in a dangerous condition. Plans for an extensive scheme of reconstruction and repair were prepared and a substantial loan towards the cost of the work was offered by the Commissioner for the Special Areas in Scotland. A final decision on the project had not been reached when the war broke out and the scheme had to be postponed. In the meantime, certain repair work has been carried out at the section of the pier which is now re-opened.

# *Correspondence*

To the Editor of "The Dock and Harbour Authority"

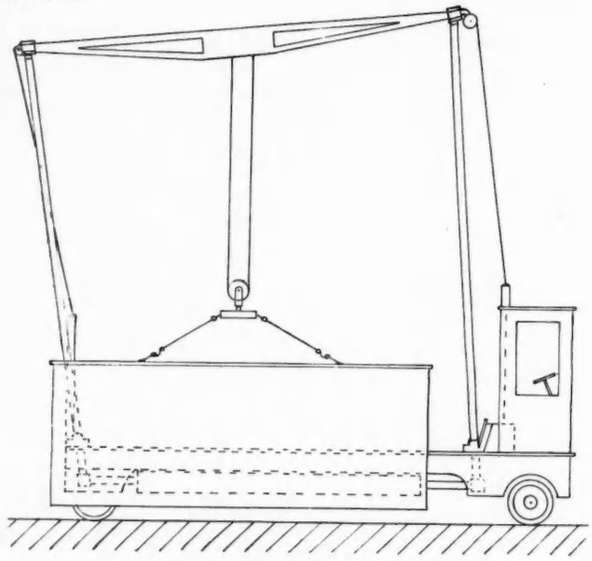
**Facilitating the Removal of Ships' Cargo**

Dear Sir,—

The need for facilitating the removal of ships' cargo from the dockside was probably never more imperative than it is at the present time, in order to give every freedom of movement alike to the ports and to the vessels themselves.

There is little doubt as to the co-operation and facilities offered by the railway services, and the cranes engaged in assisting the unloading. Where, however, the freighter is unloaded, and no trucks or waggons are at hand, there is no alternative but to discharge the contents on the nearby quay. Despite the most systematic docking of the ships, a certain state of confusion is apt to arise, if full use cannot be made of the berths, since the cranes cannot be expected to perform two duties, namely, unloading the holds, and also re-handling of loose material lying on the wharf at the same time. In short detail, the cranes appear to perform their functions satisfactorily, whilst there is little evidence of a hold-up of rail waggons.

It is in the intermediate stage that time appears to be unduly lost, since it cannot be expected that fresh trains can always be shunted into position to meet the output of continuously operated cranes. Attention, therefore, devolves upon means of expeditiously reloading cargo on the dockside, so that the cranes may work on a non-stop basis, whether or not waggons are at hand, whilst no blocking of the traffic can arise. As a general rule, this type of work is associated with excessive labour requirements, but to those acquainted with modern labour-saving devices, there should not necessarily be a demand for more dock labourers.



Loading Swing in Operation.

On the contrary, mechanical methods can carry out reloading work much more efficiently, provided that it is well organised. My object in writing is to draw attention to a type of appliance, designated a loading swing, and diagrammatically portrayed in the accompanying sketch. I saw it in use at the Hamburg dock during a visit in 1936 and I understand similar types are employed at the Manhattan wharves in New York. Small makes of these swings are fitted within waggons, whilst larger sizes are constructed on frames on specially made automobiles so that any kind of loading within a reasonable height can be attended to, and the vehicle run from place to place as required.

The aim of the loading swing is to conserve the strength of the workers, so that no manual lifting is at any time necessary. With the larger swing, the legs of the frame can be extended in telescope fashion, thus operating over a wide field, and they can lift loads of upwards of 5 tons to a height of some 15-ft. Power for driving the swing takes the form of a petrol motor, with provision for substituting an electric motor, suitably geared with the controls at the driver's hand. Unlike the emergency crane for attending to automobile breakdowns on the roads, this type of swing is equipped with a counterweight, which thus relieves the strain on the mechanism, and also compensates the deadweight of the swing. This counterweight takes a line of motion opposite to that performed by the swing itself so that the car, upon which it is housed, is not thrown out of equilibrium. The counterweight moves along a circular track underneath the platform of the car, and thus ensures the stability of the vehicle. When operating the swing, it is so tilted that the loading hook moves horizontally, and with the counterbalance provided, very little power is expended in swinging the load to and from the side of the car. The 8 horse-power motor used, takes about a minute to raise the full load to the maximum height of 15-ft. with the gear provided, but this could be readily speeded-up by substituting a more powerful motor.

So far as moving the swing sideways is concerned, the total time occupied only amounts to a matter of seconds.

Where it is desired to utilise this arrangement for railway waggons, the car is run to the side of the track, and the goods as unloaded from the ship directly fed, almost irrespective of their position on the wharf side. Some makes have a tilting motion of the swing amounting to about 20-ft. from the extremity of one position to another, which gives some indication of the ground area which it can cover.

The automobile vehicles, so far made, have not been equipped to travel rapidly, particularly when loaded, and it is said that they can scarcely reach 1½ miles per hour. It should be understood, however, that they are not intended for travelling lengthy stretches, but simply for facilitating the reloading of goods, and when they have to be transported empty from one dock to another, they require to be drawn by tractors, or other independent vehicles. Should it happen that goods have been dumped in a hurry, during an emergency, it does not follow that these will be in the closest proximity to the railway lines, which, in the ordinary way, would involve much additional labour, or alternatively, wastefully require the use a second time of the regular cranes. It is here that the foregoing loading swing comes into prominence, since it can handle almost any type of goods on the desired non-stop basis. A smaller type of loading swing deals with loads up to 1½ tons in weight, whilst a further development consists in attaching the latter directly to a set of waggons of capacious dimensions, so that each will be independent of outside handling devices, and necessitate the minimum of labour. A simpler type involves the use of a hand-crank, but this necessitates more labour, and limited loads, although the principle of giving each waggon a measure of independence is thus gained.

In reviewing the subject, it will be appreciated that provided the loading swing were to be adapted to its different capabilities, any suggestion of confusion at the dockside would cease to exist, and the freighter would be assisted in leaving port in the minimum of time.

Yours faithfully,

209, Hope Street, A. G. AREND.
Glasgow, C.2.
4th April, 1941.

# *Grand Union Canal Company*

## *Annual Meeting*

In addressing the shareholders at the annual meeting of the Grand Union Canal Company, the chairman, Mr. John Miller, referred to the appointment of Mr. Frank Pick by the Ministry of Transport to investigate the position, and the possibilities of the canal industry as a whole. Before the present war, said Mr. Miller, competition between rail, road, canal and coastwise shipping had created such an increase that no form of transport was receiving its fair reward, and enormous amounts of capital invested in those industries could never hope for even a moderate return. That state of affairs can be obviated by a system of co-ordination of all transport, and rate structures should be built up and differentials agreed in favour of the slower routes or methods, such as canals and coastwise shipping. He had always held the view that railways should cease to be owners of, or even interested in canals, for how could the canal industry expect railways to develop their waterways on modern lines? It was against their interest to do so. Railway-owned or controlled canals should be transferred to canal undertakings, and on similar lines to the railway amalgamation, four canal groups should be formed and given the necessary Government assistance to enable the transfers to take effect. The very heart of the canal industry from a traffic standpoint was in the Midlands, and real development could not take place until the railways released their stranglehold and ceased to be concerned with canals.

### Birmingham as a Port

Mr. Miller continued: Birmingham as a port is no dream, and I hope that when the war is over, and when the problem of finding employment for men has to be dealt with, the Government will realise how far behind this country is in the development of inland water transport in comparison with Germany, Belgium and France, and that serious steps will be taken to remedy this. The cost of transport of raw materials is too high if this country is to compete in the world's markets. Nationalisation of all transport is not the answer to this country's transport problems, for that would mean a greater burden on the country. I doubt very much if efficiency would be maintained and, as invariably happens, all operating costs would steadily increase year by year. It will be a national tragedy if, through Government legislation, individualism in industry is made still more difficult.

## The St. Lawrence Deep Waterway

### *Canadian Criticism of the Project*

At the Annual Meeting in May of the Canadian Pacific Railway, Sir Edward Beatty, the chairman, made some strongly adverse comments on the proposal for creating a ship channel in the St. Lawrence above Montreal. His address was read for him by Mr. D. C. Coleman.

Sir Edward reviewed briefly the history of the project, which, he said, was for the construction of hydro-electric generating plant at the International Rapids, together with the deepening and enlargement of the canals between Montreal and Lake Ontario.

The agreement reached on May 19th last between the United States and Canada, which was subject to ratification by Congress and Parliament, was one of many steps in a long series of negotiations between the two nations. New reasons for rushing the project had been advanced, namely, the need of war-time industries for additional electric power, and the possibility of constructing deep-draught vessels in shipyards on the Great Lakes. Judgment of the validity, urgency and practicability of those reasons could best be left to those who were qualified to deal with the various phases involved.

Long experience in transportation led the management of the Canadian Pacific Railway to believe that no important advantages in connection with the movement of traffic could result from this great project. The existing waterway had proved to be entirely adequate for the business which was now offering, and with minor improvements could be made entirely adequate for any that could presently be foreseen. The great volume of traffic on the Great Lakes was North American in both origin and destination, and it was but wishful thinking to assume that any important new traffic of that class could be created by merely enlarging the St. Lawrence canals. Should the canals be enlarged to the extent contemplated in the plan, it was probable that traffic would be diverted from existing railway systems. The net effect of that diversion would be to impose an additional burden on Canada, which was already beset with serious problems arising from duplication and excess of transportation facilities.

The investments of the United States and Dominion of Canada in the existing St. Lawrence waterways were already substantial. Notwithstanding that fact, toll-free navigation, a condition almost unique on similar waterways throughout the world, continued to be permitted over this route to the detriment of competing agencies of transportation. The revival of the plan therefore led him to urge strongly that the fundamental need in connection with their waterways was not large expenditures for their improvement in excess of the needs of the traffic offering, but the adoption in negotiation with the Government of the United States of a plan by which the traffic now using the canals would be taxed sufficiently to free the Dominion Treasury from at least a part of the heavy burden which had resulted from their great expenditures on waterways in the past.

## The Port of Dublin

### *Summary of Annual Report for Year 1940*

#### Parliamentary

In the report of the Dublin Port and Docks Board for the year ended December 31st last, it is stated that during the year the Bill to alter certain existing powers of the Board for the borrowing of money, and for other purposes, passed through the final stages in the Oireachtas, received the assent of the President and became law accordingly.

#### Accounts

The statement of accounts for the year 1940 shows a gross revenue of £279,781 3s. 9d., an expenditure chargeable to revenue of £274,251 9s. 3d., and a balance of £5,529 14s. 6d. The receipts from tonnage dues and dues on goods amounted to £189,462 8s. 9d., being a decrease of £4,572 9s. 2d. as compared with the year 1939. The loans outstanding at December 31st, 1940, amounted to £1,484,067 2s. 6d., the balance to the credit of the sinking funds at that date being £324,758 2s. 6d. During the year £1,430 of the Board's 3¼ per cent. Redeemable Stock was purchased and extinguished.

#### Engineering Department

The Engineer's report shows that the total quantity dredged during the year was 1,402,860 tons. The dredger "Sandpiper" worked 35 weeks on the bar, 13 weeks in the river channel, and one week at the entrance to Pigeon House Harbour. The dredger "Deepworker" was employed for 32 weeks in the river channel between the North Quay extension and Pigeon House Harbour. Another dredger worked 47 weeks clearing quay berths and two weeks in Pigeon House Harbour. The dredger "Mudfisher" was engaged mainly on construction work, but worked 11 weeks dredging in Alexandra Basin, six weeks in quay berths and three weeks removing debris from North Bank Lighthouse.

The new automatic lighthouse at North Bank was completed and put in commission, and the old lighthouse demolished. Maintenance of the North and South Quays was normal in character. Part of the North Wall Quay was repaved by the Dublin Corporation. The experimental one-way traffic system in force on part of the North Wall Quay was discontinued. Widening of the corners of Grattan Bridge was completed. Resurfacing of part of Alexandra Quay and relevelling of the tram rails was continued. The electric power cables were removed from the pipe tunnel and relaid. Maintenance of the wharves has been of a normal character but the volume of repairs required to the wharves at Custom House Quay shows a tendency to increase. Small repairs to the graving dock gates which had developed some leaks were satisfactorily carried out. A number of shores suitable for docking large vessels were provided.

At the Custom House docks and warehouses the roadway on the west side of Stack "C" was resurfaced in concrete and the road south of Tobacco Warehouse "H" repaved, part of the cost of these works being defrayed by a Government relief grant. The fire appliances store was reconstructed and and enlarged to accommodate the trailer fire pump and accessories. At the North Quay extension portions of the roadways south of No. 3 shed and north of No. 2 shed were resurfaced in concrete. The survey of the channel and bar was kept up to date and showed that the navigable depths were well maintained, slight improvements being apparent on the bar and west of Pigeon House Harbour. The first section of the Ocean Pier at the east end of Alexandra Quay, 170-ft. in length, was completed, and a further section 110-ft. long commenced. Storm damage on the Great South Wall was repaired.

As an economy measure a shorter working week was introduced on June 10th and economies have been effected wherever possible and consistent with efficient maintenance. Works undertaken for other bodies included construction of mine casings and sinkers for the Department of Defence, reconstruction of fender piles at Pigeon House Harbour for the Dublin Corporation, and alterations to the passenger hall, Alexandra Quay, which was taken over by the Port Control Service. Facilities were provided for the storage of coal reserves on the reclaimed lands and in the Custom House docks.

## The Port of Los Angeles, California, U.S.A.

### *Excerpts from Annual Report for Fiscal Year ended June 30th, 1940*

#### Commerce

The total commerce through the Port of Los Angeles during the past fiscal year was 19,931,075 tons, valued at $1,094,701,062 as compared with 18,327,890 tons, valued at $986,626,114 for the previous year.

The largest gain for the year was 581,317 tons in oil commerce. General cargo showed an increase of 234,855 tons.

#### Shipping

Vessels arriving at the port during 1940, totalled 5,598, a decrease of 168 over the preceding year. There was an increase of 80 in the number of foreign vessels.

#### Port Extension and Improvement Works

During the year, the Engineering Division continued to handle a considerable volume of work in connection with the completion of several P.W.A. harbour development projects which were under construction, and in connection with the extensive reconstruction programme necessitated by maintenance of many facilities which had reached a stage of deterioration requiring general repairs to entire wharf structures. This condition was brought about by the hasty erection of Port structures years ago, to provide facilities for the accommodation of the phenomenal increase in volume of commerce reaching the Port, which structures were built largely of untreated timber. In the general maintenance of these older structures, creosoted material is being used in place of untreated timber, and advantage is taken of the opportunity to make improvements in the design of the older facilities.

Federal grants for Public Works Administration projects had been previously made for the construction of a reinforced concrete apron wharf at Berths 57 to 60, utilising asphalt impregnated concrete piling; for the extension of the terminal facility at Berth 181 and its conversion from a cased oil facility to a combined general cargo and cased oil terminal; for the construction of a blacksmith and welding shop; for the construction of an office building for the Department's Purchasing Agent; and for an extension of the transit shed at Berth 178 and construction of general offices therein.

Plans and specifications for all except the last unit of the project were prepared and the contracts awarded during the previous fiscal year, while the shed extension and offices at Berth 178 were initiated during the current year. Construction work on these P.W.A. projects was completed during this fiscal year ending June 30th, 1940. Projects of this type are financed by Federal Grants equivalent to 45 per cent. of the cost of the project, the remainder being borne by the Harbour Department.

## *An All-Electrically-Operated Dredger*

### *Description of a New American Vessel*

The following particulars relating a new American suction cutter dredger, the " William A. Guthrie," are extracted from a recent article in *Lloyd's List*. The chief interest of the vessel lies in the fact that she is electrically operated throughout.

The dredger is designed for reclamation work on inland waterways and is manœuvred and anchored in position by means of spuds, by alternately raising and lowering which the vessel is rendered mobile or stationary as circumstances require. Propulsion is achieved by means of small diameter screws running in tunnels.

The vessel has an overall length of 200-ft. 6-in., an overall beam of 36-ft. 8½-in. and a depth at side of 8-ft. The draught is not stated, but may be taken at approximately half the moulded depth. The hull and deck-houses are all constructed of steel, fabrication and assembly having been done mainly by electric welding.

The reason for the adoption of complete electrical operation is that it permitted of centralisation of control in the large pilot house, which is located forward in an elevated position on the box-shaped superstructure. The current, of course, is mainly used for driving of the suction cutter apparatus which requires a powerful electric motor, the small diameter fast-running motors for screw propulsion being secondary in importance.

The dredging pump is of the centrifugal volute type driven by a 100 h.p. 230-volt motor, set far forward. The hoisting winch, also installed at the forward end of the dredger, is of the five-drum double reduction gear type. The winch motor is a 75 h.p. reversible unit, operating at 250-volts at 450/900 r.p.m. and is started and controlled by increasing the voltage on a 65 kw. generator and varying the motor field current. The cutter motor is compound-wound for operating on a 230-volt circuit. It is rated 150 h.p. at speeds between 300 and 600 r.p.m.

Although designed and built for highly specialised duty and therefore possessing features which would render her useless elsewhere it is claimed that the " William L. Guthrie " presents an object lesson for suction cutter dredging in other parts of the world.

## *New Floating Dock for Curtis Bay, Maryland, U.S.A.*

A contract has recently been awarded for the construction and installation of a 3,000-ton floating dock at the United States Coast Guard Depot, Curtis Bay, Maryland, by the Commandant. This floating dock will be of the longitudinally-trussed type, with steel wings and wood pontoons, consisting of five sections, which, when connected by steel pins, form a rigid dock. By the removal of four pins, any section may be separated for dry docking on the remaining sections.

The general dimensions are to be as follows:—Length over keel blocks, 300-ft.; length over all, 350-ft.; width over all, 84-ft.; width between wings, 64-ft.; depth of water over keel blocks, 20-ft.

Pumping will be done by twenty pumps, direct connected to vertical electric motors, with the control centralised in a control house ashore. Separate water level indicators will be located in the control house, each adjacent to the control of the corresponding pump, so that the interior water levels may be maintained as desired, permitting one operator to supervise the entire pumping system. The dock will be equipped with capstans, bollards, flood lights, loud speaker system and other appurtenances.

The consulting engineer for the design and supervision is Mr. J. Stuart Crandall, of Crandall Dry Dock Engineers, Inc., Cambridge, Massachusetts. The contractor is Tuller Construction Company, of Red Bank, New Jersey. It is anticipated that the floating dock will be in operation early in 1942.

**Great Yarmouth Port and Haven Commission.**

An Order has been made, whereby Sections 32 and 33 of the Great Yarmouth Port and Haven Commissioners principal Act shall not apply for the purpose of filling any occasional vacancy arising among the elected Commissioners before the close of the yearly meeting of the Commissioners in the year 1942. Any such vacancy shall be filled by the co-option; (a) in the case of a vacancy in the office of the Commissioner representing the persons registered in the yacht-owners' list by the remaining elected Commissioners, and (b) in the case of a vacancy among the Commissioners representing either of the other bodies of persons mentioned in the said paragraph (B) of Section 7 of the principal Act, by the remaining Commissioners representing that body, of a person who would be qualified, in accordance with the proviso to the said section seven and with section eight of the principal Act, to be elected to fill the vacancy at an election held on the date of co-option. Under this Order any person so co-opted shall continue in office for the same period as the person for whom he is substituted would have been entitled to continue in office.

## *Retirement of Dublin Port Engineer*

**Mr. Joseph Mallagh,** B.A., B.E., M.Inst.C.E., retired on the 30th April last from the position of Engineer-in-Chief to the Port of Dublin.

He was appointed in 1917 after 12 years service with the Sligo Harbour Commissioners as their engineer. Acting on his advice, the Dublin Port Board initiated co-ordinated schemes for the development of the Port, including the provision of the necessary facilities for the North Atlantic and Continental trades as regards depth and extent of berthage.

In the creation of deep water berthage at Alexandra Quay, he developed a form of construction by the use of large hollow monoliths, floated into position, which had not been previously used in Eire or Great Britain.

Many improvements connected with the equipment of the Port were due to his initiative. He also collaborated in the design of apparatus for, and established the first fully automatic lighthouse, including fog signal for navigational purposes.

He was responsible for large schemes of reclamation as sites for industrial development.

## *Port Welfare Committees*

An aspect of port operation which is not being overlooked at the present time by the Government is the welfare of seamen. In pursuance of a recommendation concerning the Promotion of Seamen's Welfare in Ports, which was adopted in 1936 by the General Conference of the International Labour Organisation, assembled at Geneva, the Minister of Labour formed a Seamen's Welfare Board to advise him on all questions concerning the welfare of British, Allied and foreign seamen in British ports and of the crews of British ships in oversea ports.

This Board decided to establish Port Welfare Committees at eight British ports, viz., London, Bristol, Hull (with Grimsby), Merseyside, Newcastle (for the Tyne and Blyth), Glasgow (for the Clyde area), Leith (for the Firth of Forth), and Cardiff (including Barry docks). These committees, on which trade unions, owners and voluntary organisations are all represented, are developing and co-ordinating welfare work for seamen in their respective areas, with a view to economy of effort, and money and the realisation of greater efficiency. They are paying special attention to the needs of Allied and foreign seamen in collaboration with Port Hospitality Committees, which had previously been formed for the same purpose at some of the ports.

Where Port Welfare Committees have been established, Seamen's Welfare Officers have been appointed to act as Secretaries to the Committees. It is their duty to assist the organisations connected with seamen's welfare in their area. They work in close collaboration with the local officers of other Government Departments concerned in seamen's welfare and with officers of the local authorities.

Among the matters affecting British, Allied and foreign seamen, while on shore in Great Britain, to which attention is being given are the difficulties which some voluntary organisations providing hostels for seamen are experiencing in obtaining sufficient supplies for food and also of cigarettes and tobacco; the lack of suitable accommodation for seamen in certain ports; and safety precautions at docks. Special consideration is also being given to the welfare of seamen suffering as a result of enemy action.

**Record Tonnage at Table Bay.**

At Table Bay Harbour there has recently been handled the largest tonnage of shipping ever dealt with at the port in one day. Twenty ships docked on one day in January and their gross tonnage totalled 284,057 tons. The number of ships berthed in the harbour during January averaged twenty-one a day, while in addition, the average daily number lying in the bay awaiting berths was eleven.

**New Temporary Wharf at St. John, N.B.**

Temporary additions to the harbour accommodation at St. John, N.B., are contemplated by the Canadian Government to meet war-time demands. It is proposed to build a structure, 900-ft. long and 60-ft. wide, with a 30-ft. draught (for ocean Vessels) on the deep-water side, and a shallow draught of approximately 12-ft. on the south side for the accommodation of cargo lighters. Three railway tracks will be laid on the structure, which will be located on the west side immediately north of the Rodney Wharf side of berth No. 4.

**Business Announcement.**

We are requested to announce that Messrs. Thomas Norman Frederick Smith (son of the Joint Managing Director) and Charles Walls (for over 20 years General Manager) have joined the Directorial Staff of Messrs. Thomas Smith and Sons (Rodley) Ltd., the well-known crane makers.